ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

Austria's Informative Inventory Report (IIR) 2013

Submission under the UNECE Convention on Long-range Transboundary Air Pollution

AUSTRIA'S INFORMATIVE INVENTORY REPORT (IIR) 2013

Submission under the UNECE Convention on Long-range Transboundary Air Pollution

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This report was prepared on behalf of the Austrian *Federal Ministry of Agriculture, Forestry, Environment and Water Management*.

This report replaces the one designated as DRAFT submitted on March 15th 2013.

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EXECUTIVE SUMMARY

The report "Austria's Informative Inventory Report (IIR) 2013" provides a complete and comprehensive description of the methodologies used for the compilation of Austrian's Air Emission Inventory ("Österreichische Luftschadstoff-Inventur – OLI") as presented in Austria's 2013 submission under the Convention on Long-range Transboundary Air Pollution of the United Nations Economic Commission for Europe (UNECE/LRTAP).

The aim of this report is to document the methodology in order to facilitate understanding of the calculation of the Austrian air pollutant emission data. The more interested reader is kindly refered to the background literature cited in this document.

As a party to the UNECE/LRTAP Convention Austria is required to annually report data on emissions of air pollutants covered in the Convention and its Protocols: these are the main pollutants NO_x, SO_2, NMVOC, NH_3 and CO, Particulate Matter (PM), Persistent Organic Pollutants (POPs) and Heavy Metals (HM). To be able to meet this reporting requirement Austria compiles an Air Emission Inventory ("Österreichische Luftschadstoff-Inventur – OLI") which is updated annually.

This report follows the regulations under the UNECE/LRTAP Convention and its Protocols that define standards for national emission inventories. In 2008 the Executive Body adopted guidelines for estimating and reporting of emission data, which are necessary to ensure that the transparency, accuracy, consistency, comparability, and completeness (TACCC) of reported emissions are adequate for current Guidelines for Reporting Emission Data under the Convention on Long-Range Transboundary Air Pollution (LRTAP) (ECE/EB.AIR/97)[1/2]. The emission data presented in this report were compiled according to these guidelines for estimating and reporting emission data, which also define the new format of reporting emission data (**N**omenclature **f**or **R**eporting – NFR (latest version of the templates 'NFR09'[3] dated 30.9.2009)) as well as standards for providing supporting documentation which should ensure the transparency of the inventory.

The complete set of tables in the new NFR format, including sectoral reports, sectoral background tables and footnotes to the NFR tables, are submitted separately in digital form only. The NFR for 2011 and a summary of emission data is presented in the Annex of this report.

The IIR 2013 at hand complements the reported emission data by providing background information. It follows the template[4] of the "Informative Inventory Report – IIR" as elaborated by the LRTAP Convention's "Task Force on Emission Inventories and Projections – TFEIP". The structure of this report follows closely the structure of Austria's National Inventory Report (NIR) submitted annually under the United Nations Framework Convention on Climate Change (UNFCCC) which includes a complete and comprehensive description of methodologies used for compilation of Austria's greenhouse gas inventory (UMWELTBUNDESAMT 2013a).

The first chapter of this report provides general information on the institutional arrangements for inventory preparation, on the inventory preparation process, methodologies and data sources used and on QA/QC activities. Furthermore it presents the Key Category Analysis and gives information on completeness and uncertainty of emission estimates.

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[1] www.ceip.at/fileadmin/inhalte/emep/reporting_2009/Rep_Guidelines_ECE_EB_AIR_97_e.pdf

[2] At its twenty-sixth session (15–18 December 2008), the Executive Body approved the revised Guidelines (ECE/EB.AIR/2008/4) as amended at the session and requested the secretariat to circulate a final amended version.

[3] NFR09 - http://www.ceip.at/reporting-instructions/annexes-to-the-reporting-guidelines/

[4] www.ceip.at/fileadmin/inhalte/emep/doc/AnnexVI_IIR_300909.doc

Chapter 2 gives information on the Protocols to the Convention and actual emission trends by sector.

The third chapter presents major changes (so called "recalculations") related to the previous submission (emission data report 2012 under the UNECE/LRTAP Convention), which are the result of continuous improvement of Austria's Air Emission Inventory. Data presented in this report replace data reported earlier under the reporting framework of the UNECE/LRTAP Convention.

Chapters 4 to 8 include detailed information on the methodologies and assumptions used for estimating NO_x, SO_2, NMVOC, NH_3 and CO, PM, POPs and HM emissions in Austria's Air Emissions Inventory.

The annex presents inter alia emission data for all pollutants for the year 2011 in NFR as well as trend tables for these gases and for heavy metals, POPs and particulate matter.

The preparation and review of Austria's National Air Emission Inventory are the responsibility of the Department "Air Pollution Control & Climate Change Mitigation" of the Umweltbundesamt.

Project leader for the preparation of the IIR 2013 is Traute Köther.

Project leader for the preparation of the Austrian Air Pollutant Inventory (OLI) is Stephan Poupa.

Specific responsibilities for the IIR 2013 have been as follows:

- Executive Summary .... Traute Köther
- Chapter 1 Introduction.................................... Traute Köther, Andreas Zechmeister
- Chapter 2 Trends .... Simone Haider, Traute Köther
- Chapter 3 Energy .... Stephan Poupa
- Chapter 3 Transport .... Gudrun Stanner
- Chapter 3 Fugitive emission........................... Sabine Schindlbacher, Traute Köther
- Chapter 4 Industrial Processes...................... Traute Köther, Heide Jobstmann
- Chapter 5 Solvents.. Traute Köther
- Chapter 6 Agriculture .... Michael Anderl
- Chapter 7 Waste .... Katja Pazdernik
- Chapter 8 Recalculations & Improvements… Traute Köther
- Chapter 9 Projections.................................... Andreas Zechmeister
- Annexes .... Traute Köther.

1 INTRODUCTION

1.1 Institutional Arrangement for Inventory Preparation

Austria's reporting obligations to the

- Convention on Long-range Transboundary Air Pollution (LRTAP)[5] of the United Nations Economic Commission for Europe (UNECE)[6],
- United Nations Framework Convention on Climate Change (UNFCCC)[7],
- European Commission (EC)[8], and as well as the
- European Environment Agency (EEA)[9].

are administered by the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW)[10]. The Environmental Control Act ("Umweltkontrollgesetz"; Federal Law Gazette 152/1998)[11] that entered into force on the 1st of January 1999 regulates responsibilities of environmental control in Austria and lists the tasks of the Umweltbundesamt. The Umweltbundesamt is designated as single national entity with overall responsibility for inventory preparation.

Furthermore, the Environmental Control Act incorporates the Umweltbundesamt as private limited company; to assure that the Umweltbundesamt has the resources required to fulfil all listed tasks, the financing is set up as a fixed amount of money annually allocated to the Umweltbundesamt. The Umweltbundesamt is free to manage this so called "basic funding", provided that the tasks are fulfilled. Projects beyond the scope of the Envirionmental Control Act are financed on project basis by the contracting entity, which are national or EC authorities as well as private entities.

One task is the preparation of technical expertise and the data basis for fulfilment of the obligations under the UNFCCC and the UNECE LRTAP Convention. Thus the Umweltbundesamt prepares and annually updates the Austrian air emissions inventory ("Österreichische Luftschadstoff-Inventur OLI"), which covers greenhouse gases and emissions of other air pollutants as stipulated in the reporting obligations further explained in chapter 1.1.1.

For the Umweltbundesamt a national air emission inventory that identifies and quantifies the sources of pollutants in a consistent manner is of a high priority. Such an inventory provides a common means for comparing the relative contribution of different emission sources and hence can serve as an important basis for policies to reduce emissions.

Within the Umweltbundesamt the department of *Air Pollution Control & Climate Change Mitigation* is responsible for the preparation of the Austrian Air Emission Inventory ("Österreichische Luftschadstoff-Inventur OLI") and all work related to inventory preparation. Responsibilities are divided by sectors between sector experts from Departments within the Umweltbundesamt (see Figure 1). The quality system is maintained up to date under the responsibility of the Quality Manager.

The "*Inspection body for GHG inventory*" within the Umweltbundesamt is responsible for the compilation of the greenhouse gas inventory (UNFCCC and Kyoto-Protocol as well as EC Monitoring mechanism), whereas the "*Air Emission Inventory-Team*" is responsible for the compilation of the air emission inventory (UNECE and NEC). Within the Umweltbundesamt an ISO

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[5] http://www.unece.org/env/lrtap/

[6] http://www.unece.org

[7] http://unfccc.int/2860.php

[8] http://ec.europa.eu/index_en.htm

[9] http://www.eea.europa.eu/

[10] http://www.lebensministerium.at/

[11] http://www.umweltbundesamt.at/fileadmin/site/umweltkontrolle/gesetze/ukg.pdf

17020 accredited inspection body for Emission Inventories (Id. No. 241) has been established in accordance with the Austrian Accreditation Law (AkkG)[12] by decree of the Minister of Economics and Labour (BMWA), issued on 19.01.2006, valid from 23.12.2005.[13] The requirements of EN ISO/IEC 17020 (Type A)[14] are fulfilled. The current accreditation comprises the full GHG-inventory and main pollutants of the NEC-inventory (see Chapter 1.5).

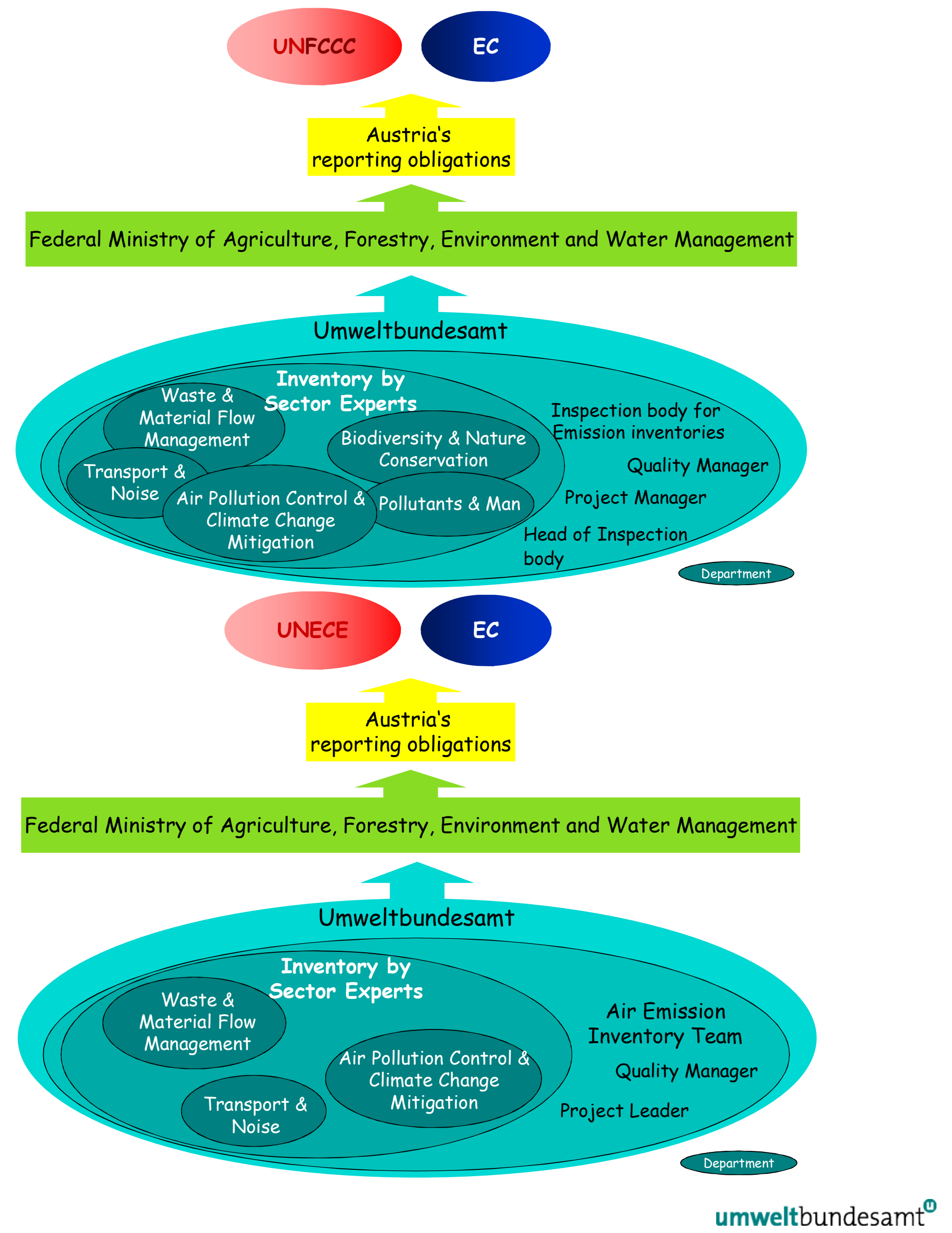

Figure 1: Responsibilities in the Austrian National System for Greenhouse Gas Inventories and Air Emission Inventories.

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[12] Federal Law Gazette No. 468/1992 last amended by federal law gazette I No. 85/2002, by decree of the Minister of Economics and Labour, No. BMWA- 92.715/0036-I/12/2005, issued on 19 January, valid from 23 December 2005. http://www.bmwa.gv.at/NR/rdonlyres/4E4C573C-4628-4B05-9DB6-D0A7C6E7EF81/216/Akkreditierungsgesetz_Englisch1.pdf

[13] http://www.bmwa.gv.at/NR/rdonlyres/E956BE3D-B8A9-4922-9A2A-420182E8ED7A/22576/Akkrd.pdf

[14] http://www.bmwa.gv.at/NR/rdonlyres/3F9073D6-1F51-4AB7-BBD3-687B82EC0479/0/ LeitfadenL10zur Anwen-dungderISO17020V2.pdf

1.1.1 Austria's Obligations

Austria has to comply with the following air emission related obligations:

- Austria's obligation under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP) and its Protocols comprising the annual reporting of national emission data on SO_2, NO_x, NMVOCs, NH_3, CO, TSP, PM10, and PM2.5 as well as on the heavy metals Pb, Cd and Hg and persistent organic hydrocarbons (PAHs), dioxins and furans (PCDD/F) and hexachlorobenzene (HCB). Austria signed the convention in 1979; since its entry into force in 1983 the Convention has been extended by eight protocols which identify specific obligations or measures to be taken by Parties. These obligations as well as information regarding the status of ratification are listed in Table 1.
- Austria's annual obligations under the Directive 2001/81/EC of the European Parliament and of the Council of 23.10.2001 on national emission ceilings for certain atmospheric pollutants (NEC-Directive).[15] The Austrian implementation of the European NEC-Directive[16] also entails the obligation for a national emissions inventory of the covered air pollutants NO_x, SO_2, NMVOC and NH_3.
- Austria's obligation under the „United Nations Framework Convention on Climate Change (UNFCCC) (1992)[17] and the Kyoto Protocol (1997)[18].
- Austria's annual obligations under the European Council Decision 280/2004/EC[19] "Monitoring Decision" concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.
- Obligation under the Austrian "ambient air quality law"[20] comprising the reporting of national emission data on SO_2, NO_x, NMVOC, CO, heavy metals (Pb, Cd, Hg), benzene and particulate matter (PM).
- Austria's obligation according to Article 15 of the European IPPC Directive 1996/61/EC[21] is to implement a European Pollutant Emission Register (EPER). EPER was displaced and upgraded by regulation (EC) No 166/2006[22] concerning the establishment of a European Pollutant Release and Transfer Register (E-PRTR Regulation). EPER and E-PRTR are associated with Article 6 of the Aarhus Convention (United Nations: Aarhus, 1998) which refers to the right of the public to access environmental information and to participate in the decision-making process of environmental issues.

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[15] http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/luft/Richtlinie_2001.81.EG.pdf

[16] Emissionshöchstmengengesetz-Luft *EG-L* (*air emissions ceilings law*) BGBl. I, 34/2003
http://www.umweltbundesamt.at/fileadmin/site/umweltkontrolle/gesetze/EG-L.pdf

[17] http://unfccc.int/files/essential_background/convention/status_of_ratification/application/pdf/ratlist.pdf

[18] http://unfccc.int/files/essential_background/kyoto_protocol/application/pdf/kpstats.pdf

[19] http://europa.eu.int/eur-lex/pri/de/oj/dat/2004/l_049/l_04920040219de00010008.pdf
(replacing Decision 389/1992/EEC amended by Decision 296/1999/EEC)

[20] Immissionsschutzgesetz-Luft *IG-L* (*ambient air quality law*) BGBl, I, 115/1997
http://www.umweltbundesamt.at/fileadmin/site/umweltkontrolle/gesetze/2001-IG-L.pdf

[21] http://eippcb.jrc.es/pages/Directive.htm

[22] see www.umweltbundesamt.at/eper/; http://www.umweltbundesamt.at/umweltinformation/datenbanken/prtr/
and http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:052:0003:0005:EN:PDF

Table 1: Protocols of UNECE Convention on Long-range Transboundary Air Pollution (LRTAP).

	Tools of UNECE Convention on Long-range Transboundary Air Pollution (LRTAP)	**Parties**	**entered into force**	**signed/ratified by Austria**
1979	Convention on Long-range Transboundary Air Pollution (in Geneva)		16.03.1983	13.11.1979 (s) 16.12.1982 (r)
1984	Geneva Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)	44	28.01.1988	04.06.1987 (ac)
1985	Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent	25	02.09.1987	09.07.1985 (s) 04.06.1987 (r)
1988	Sofia Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes	34	14.02.1991	01.11.1988 (s) 15.01.1990 (r)
1991	Geneva Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes	24	29.09.1997	19.11.1991 (s) 23.08.1994 (r)
1994	Oslo Protocol on Further Reduction of Sulphur Emissions	29	05.08.1998	14.06.1994 (s) 27.08.1998 (r)
1998	Aarhus Protocol on Heavy Metals	33	29.12.2003	24.06.1998 (s) 17.12.2003 (r)
1998	Aarhus Protocol on Persistent Organic Pollutants (POPs)	33	23.10.2003	24.06.1998 (s) 27.08.2002 (r)(1)
1999	The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone	25	17.05.2005	01.12.1999 (s)

Abbreviation: signed (s) ratified (r) accession (ac) Footnote: (1) with declaration upon ratification

Source: ***http://www.unece.org/env/lrtap/welcome.html***

1.1.2 National Inventory System Austria (NISA)

History of the National Inventory System Austria - NISA

Austria's National Inventory System (NISA) has to be adapted to different obligations which are subject to continuous development. A brief history of the development and the activities of NISA is shown here:

- Austria established estimates for SO_2 under EMEP in 1978 (Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe)[23].
- As an EFTA[24] country Austria participated in CORINAIR 90[25/26], which was an air emission inventory for Europe. It was part of the CORINE (Coordination d'Information Environmentale) work plan set up by the European Council of Ministers in 1985. The aim of CORINAIR 90 was to produce a complete, consistent and transparent emission inventory for the pollutants: SO_x as SO_2, NO_x as NO_2, NMVOC, CH_4, CO, CO_2, N_2O and NH_3.
- Austria signed the UNFCCC on June 8, 1992 and subsequently submitted its instrument of ratification on February 28, 1994.[27]
- In 1994 the first so-called Austrian Air Emission Inventory (Österreichische Luftschadstoff-Inventur, OLI) was prepared.
- In 1997 a consistent time series for the emission data from 1980 to 1995 was reported for the first time.
- In 1998 also emissions of heavy metals (HM), persistent organic pollutants (POP) and fluorinated compounds (FC) such as SF_6, PFCs, HFCs were included in the inventory.
- Austria signed the KYOTO PROTOCOL on April 4, 1998 and subsequently submitted its instrument of ratification on May 31, 2002.
- Inventory data for particulate matter (PM) were included in the inventory in 2001.
- In 2005 Accreditation according to ISO/IEC 17020 as Inspection Body for Emission Inventories which has been reviewed in 2011.

For more details on NISA see the report "NISA – NATIONAL INVENTORY SYSTEM AUSTRIA – Implementation Report"[28] which presents an overview of NISA and evaluates its compliance with the guidelines for national systems under Article 5, paragraph 1, of the Kyoto Protocol as specified under the Marrakesh Accord (decision 20/CP.7)[29].

Organisation of the National Inventory System Austria - NISA

Regulations under the UNECE/LRTAP Convention and its Protocols define and continuously improve standards for the preparation of and reporting on national emission inventories. In 2002, the Executive Body[30] adopted new guidelines for estimating and reporting emission data to ensure that the transparency, consistency, comparability, completeness and accuracy of reported

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[23] http://projects.dnmi.no/~emep/

[24] EFTA: European Free Trade Association; http://www.efta.int/

[25] The CORINAIR system has been integrated into the work programme of the European Environment Agency (EEA) and the work is continuing through the Agency's European Topic Centre on Air Emissions (ETC/ACC) (http://air-climate.eionet.europa.eu/). http://reports.eea.europa.eu/topic_report_1996_21/en/topic_21_1996.pdf

[26] http://reports.eea.eu.int/92-9167-036-7/en

[27] http://unfccc.int/parties_and_observers/parties/items/2146.php

[28] http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0004.pdf

[29] http://unfccc.int/cop7/accords_draft.pdf

[30] http://www.unece.org/env/lrtap/ExecutiveBody/welcome.html

emissions are adequate for current LRTAP Conventions needs (EB.AIR/GE.1/2002/7[31] and its supporting addendum).

The submission is in accordance with the revised Guidelines for Reporting Emission Data under the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/97; 30th September 2009)1.

As illustrated in Figure 2 the Austrian Air Emission Inventory (OLI) comprising all air pollutants stipulated by various national and international obligations is the centre of NISA. The national system as required under the Kyoto Protocol and the Quality Management System (ISO/IEC 17020) are incorporated into NISA as complementary sections.

The Austrian air emission inventory (OLI) covers all pollutants, i.e. air pollutants reported to UNECE and greenhouse gases (GHG) as reported to the UNFCCC to streamline efforts and benefit from a common approach to inventory preparation in one single National Inventory System for Austria (NISA).

It is designed to comply with the (in general more stringent) standards for national emission inventories under the UNFCCC and the Kyoto Protocol and also meets all the requirements of the LRTAP Convention and other reporting obligations as presented above (Chapter 1.1.3).

The "National Inventory System Austria" (NISA) includes all institutional, legal and procedural arrangements made for the preparation of emission inventories and for reporting and archiving inventory information and should ensure the quality of the inventory: timeliness, transparency, accuracy, consistency, comparability, and completeness (TACCC).

As there are many different obligations which are subject to continuous development, Austria's National Inventory System (NISA) has to be adapted continually to these changes. The present structure is illustrated in Figure 2.

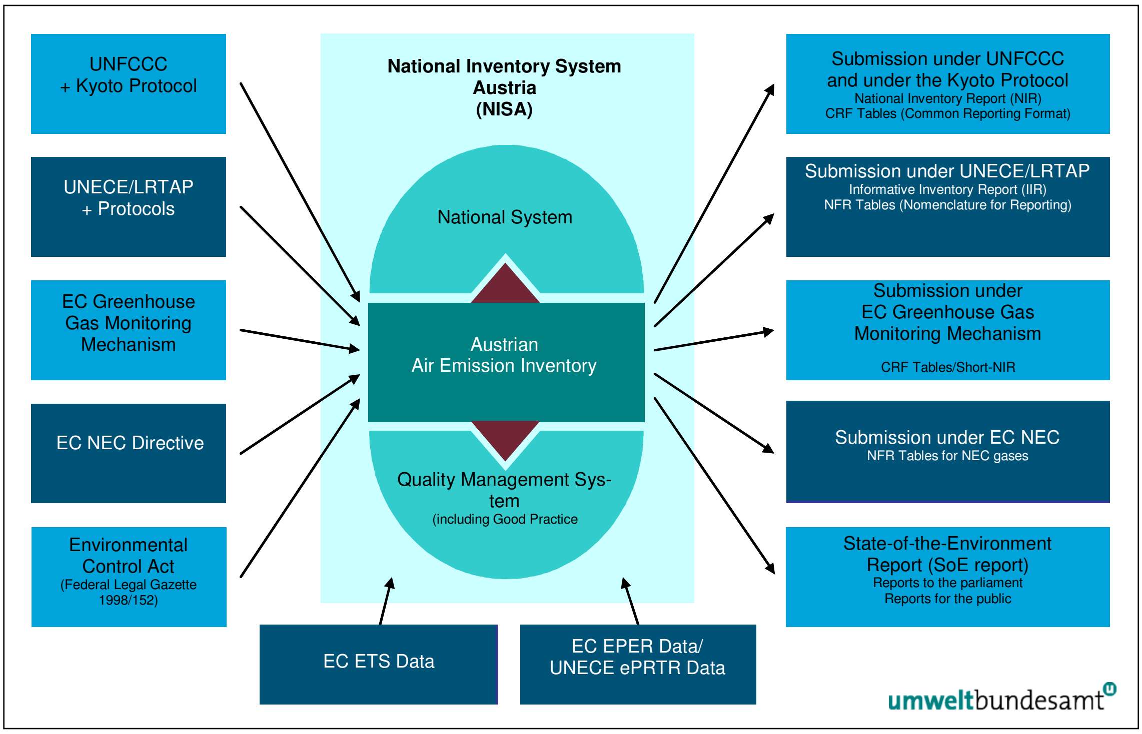

Figure 2: Structure of National Emission Inventory System Austria (NISA).

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[31] http://www.unece.org/env/eb/welcome.20.html

1.1.3 Reporting obligation under the UNECE/LRTAP Convention and its Protocols

As a minimum requirement, each Party shall report on emissions of the substances relevant to the Protocol to which they are a Party, as required by that Protocol. Since Austria has signed all eight protocols of the UNECE/LRTAP Convention, the annual reporting obligation enfolds emission data of four groups: main pollutants, particulate matter (PM), heavy metals, and POPs. Table 2, taken from the reporting guidelines, gives the present set of components which have to be reported (minimum) and which should be reported voluntarily (additionally).

This report follows the regulations under the UNECE/LRTAP Convention and its Protocols that define standards for national emission inventories. In 2008 the Executive Body adopted guidelines for estimating and reporting of emission data, which are necessary to ensure that the transparency, accuracy, consistency, comparability, and completeness (TACCC) of reported emissions are adequate for current Guidelines for Reporting Emission Data under the Convention on Long-Range Transboundary Air Pollution (LRTAP) (ECE/EB.AIR/97) 1/2.

The emission data presented in this report were compiled according to the reporting guidelines for estimating and reporting emission data, which also define the new format of reporting emission data (**N**omenclature **f**or **R**eporting – NFR (latest version of the templates 'NFR09'[32] dated 30.9.2009)) as well as standards for providing supporting documentation which should ensure the transparency of the inventory.

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[32] NFR09 - http://www.ceip.at/reporting-instructions/annexes-to-the-reporting-guidelines/

Table 2: Emission Reporting Programme: YEARLY (MINIMUM and ADDITIONAL).

YEARLY	Components (Minimum and ***additional***)	Reporting years (1)
A. National totals		
1. Main pollutants	SO_x, NO_x, NH_3, NMVOC, CO	from 1980 to 2011
2. Particulate matter	PM2.5, PM10, TSP	for 1990, 1995, and for 1999 to 2011
3. Heavy metals	Pb, Cd, Hg, *As, Cr, Cu, Ni, Se, Zn*	from 1985 to 2011
4. POPs	Hexachlorobenzene (HCB), hexachlorocyclohexane (HCH), polychlorinated biphenyls (PCBs), dioxins/furans (PCDD/F), polycyclic aromatic hydrocarbons (PAHs) (See rev.Emission Reporting Guidelines ECE/EB.AIR/97	from 1985 to 2011
B. Sector emissions		
1. Main pollutants	SO_x, NO_x, NH_3, NMVOC, CO	from 1980 to 2011
2. Particulate matter	PM2.5, PM10, TSP	for 1990, 1995, and for 1999 to 2011
3. Heavy metals	Pb, Cd, Hg, *As, Cr, Cu, Ni, Se, Zn*	from 1985 to 2011
4. POPs	aldrin, chlordane, chlordecone, DDT, dieldrin, endrin, heptachlor, HCB, mirex, toxaphene, HCH, hexabromobiphenyl, PCBs, PCDD/F, PAHs, SCCP, PCP	from 1985 to 2011
5-YEARLY: MINIMUM REPORTING		
C. Gridded data in the EMEP 50 x 50 km^2 grid		
1. National totals	Main pollutants, PM, Pb, Cd, Hg, PAHs, HCH, HCB, PCBs, PCDD/F	1990, 1995, 2000, 2005, 2010 (PM: 2000 and 2005, 2010)
2. Sector emissions		
D. Emissions from large point sources		
	Main pollutants, PM, Pb, Cd, Hg, PAHs, HCH, HCB, PCBs, PCDD/F	1990, 1995, 2000,2005, 2010 (PM for 2000 and 2005, 2010)
E. Historical and Projected activity data and projected national total emissions		
1. National total emissions	See table IV 2A in the Emission Reporting Guidelines ECE/EB.AIR/97 (27 January 2009)	2010, 2015, 2020, 2030 and 2050
2. National sector emissions	See tables IV 2B, 2C in the Emission Reporting Guidelines ECE/EB.AIR/97 (27 January 2009)	1990, 1995, 2000, 2005, 2010, 2015, 2020, 2030 and 2050
3. National projection activity data	See table IV 2D in the Emission Reporting Guidelines ECE/EB.AIR/97 (27 January 2009)	1990, 1995, 2000, 2005, 2010, 2015, 2020, 2030 and 2050
5-YEARLY: ADDITIONAL REPORTING/FOR REVIEW AND ASSESSMENT PURPOSES		
VOC speciation/Height distribution/Temporal distribution		Parties are encouraged to review the information used for modelling at the Meteorological Synthesizing Centres available for review at http://webdab.emep.int/ and the Additional Reporting Tables
Land-use data/Mercury breakdown		
% of toxic congeners of PCDD/F emissions		
Pre-1990 emissions of PAHs, HCB, PCDD/F and PCB		
Information on natural emissions		

(1) *As a minimum, data for the base year of the relevant protocol and from the year of entry into force of that protocol to the latest year should be reported*

1.2 Inventory Preparation Process

The present Austrian Air Pollutant Inventory (OLI) for the period 1980 to 2011 was compiled according to the recommendations for inventories as set out by the UNECE Executive Body[33] and in the guidelines mentioned above.

The preparation of the inventory includes the following three stages as illustrated below.

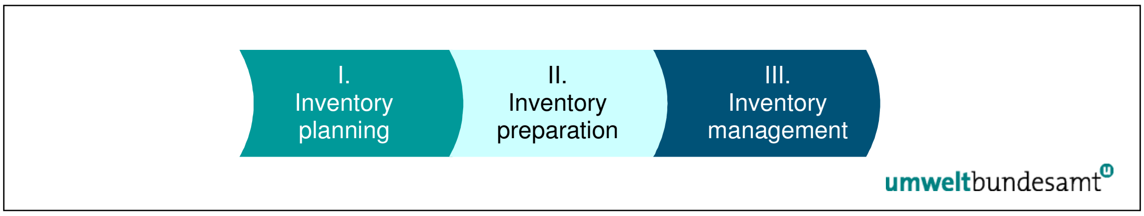

Figure 3: Three stages of inventory preparation.

I Inventory planning

In the first stage specific responsibilities are defined and allocated: as mentioned before, the Umweltbundesamt has the overall responsibility for the national inventory, comprising greenhouse gases as well as other air pollutants.

Inventory planning also includes planning of how to distribute available resources, and thus, as resources are limited, also includes a prioritization of planned improvements. Considerations on which part of the inventory (in terms of pollutants and/or sectors) to focus efforts to improve the inventory include political or public awareness due to current environmental problems or emission reduction limits that are hard to meet. A tool to prioritize between sectors within the inventory is the Key Category Analysis, where efforts are focused on important sources/sectors in terms of emissions, trends or concerning the influence on the overall quality of the inventory.

In the Austrian inventory improvement programme emphasis has been laid on the so-called NEC gases SO_x, NO_x, NMVOC, and NH_3. However, in the previous year, emissions from HM, PM and POPs have been re-evaluated and updated where possible.

Within the inventory system specific responsibilities for the different emission source categories are defined ("sector experts") as well as for all activities related to the preparation of the inventory, including QA/QC, data management and reporting.

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[33] http://www.unece.org/env/eb/welcome.html

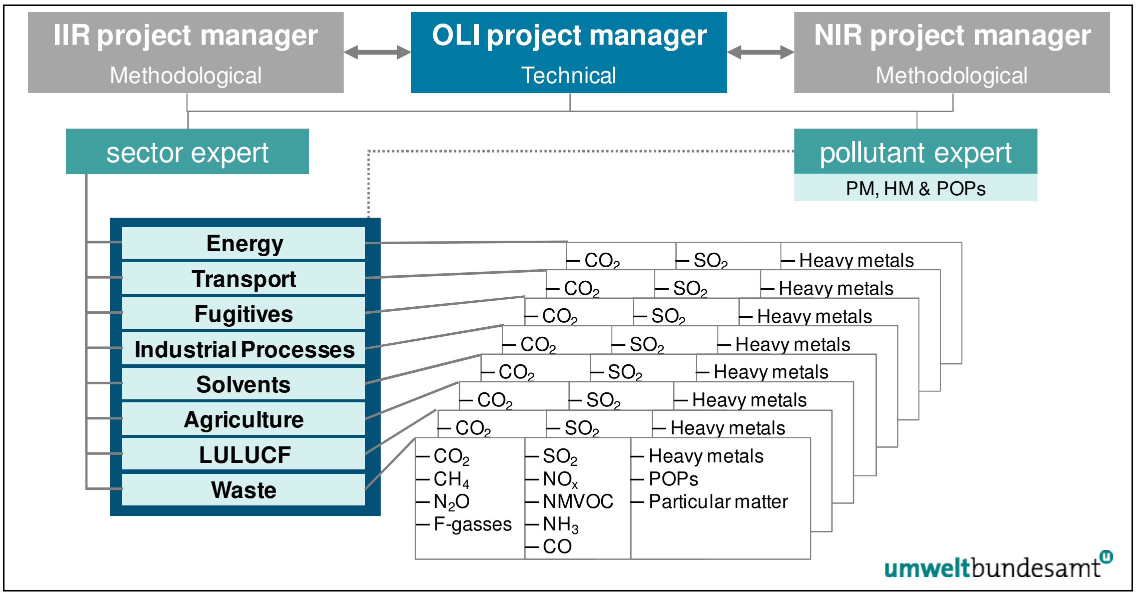

Figure 4: Roles and responsibilities within the National Emission Inventory System Austria (NISA).

Emissions of air pollutants are estimated together with greenhouse gases in a single data base based on the CORINAIR[34] systematic, which was formerly also used as reporting format under the UNECE. This nomenclature was designed by the ETC/ACC[35] to estimate emissions of all kind of air pollutants as well as greenhouse gases.

The CORINAIR system's nomenclature is called SNAP[36], which may be expanded to adapt to national circumstances by so-called SPLIT codes, and additionally each SNAP/SPLIT category can be extended using a fuel code.

II Inventory preparation

In the second stage, the inventory preparation process, sector experts collect activity data, emission factors and all relevant information needed for finally estimating emissions. The sector experts are also responsible for methodological choices and for contracting studies, if needed.

As the source of emission factors and/or the methodology of emission estimation for HM, POPs and PM is different compared to the "main" pollutants for a lot of source categories, emission inventories for these pollutants were prepared in studies that were contracted out; however, the incorporation into the inventory system and the update of emission calculations for subsequent years is the responsibility of the sector experts.

All data collected together with emission estimates are fed into a database (see below), where data sources are documented for future reconstruction of the inventory.

As mentioned above, the Austrian Inventory is based on the SNAP systematic, and has to be transformed into the current reporting format under the LRTAP Convention – the NFR[37] format.

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[34] CORINAIR: CORINE – CO-oRdination d'INformation Environnementale and include a project to gather and organise information on emissions into the air relevant to acid deposition; Council Decision 85/338/EEC (OJ, 1985)

[35] European Topic Centre on Air Emissions http://air-climate.eionet.europa.eu/

[36] SNAP (Selected Nomenclature for sources of Air Pollution) 90 or 97 respectivley means the stage of development

Additionally to actual emission data also background tables of the NFR are filled in by the sector experts, and finally QA/QC procedures as defined in the inventory planning process are carried out before the data is submitted under the UNECE/LRTAP.

III Inventory management

For the inventory management a reliable data management to fulfil the data collecting and reporting requirements is needed. As mentioned above, data collection is performed by the different sector experts and the reporting requirements grow rapidly and may change over time.

Data management is carried out by using MS Excel^{TM} spreadsheets in combination with Visual Basic^{TM} macros, which is a very flexible system that can easily be adjusted to new requirements. The data is stored on a central network server which is backed up continuously for the needs of data security. The inventory management also includes quality management (see Chapter 1.5) as well as documentation on QA/QC activities.

1.3 Methodologies and Data Sources Used

Emission estimates should be prepared using the methodologies agreed upon by the Executive Body. These are in particular:

- EMEP/CORINAIR Emission Inventory Guidebook
  - 2nd edition – 1999. EEA Technical Report No. 30.
  - 3rd edition October 2002 UPDATE. EEA Technical report No 30[38]
  - 2006, EEA Technical report No 11/2006[39]
  - 2007, EEA Technical report No 16/2007[40]
- EMEP/EEA air pollutant emission inventory guidebook – 2009. Technical report No. 6/2009.[41] (previously know as EMEP/CORINAIR Emission Inventory Guidebook)
- EEA core set of indicators – Guide, EEA Technical report No 1/2005[42]
- Recommendations for Revised Data Systems for Air Emission Inventories, Topic report No. 12/1996[43]
- Guidance Report on preliminary assessment under EC air quality directives, EEA Technical report No. 11[44].

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[37] NFR – Nomenclature For Reporting – is a classification system developed by the UN/ECE TFEIP for the Reporting Guidelines described in eb.air.ge.1.2001.6.e.doc

[38] http://reports.eea.europa.eu/EMEPCORINAIR3/en/page002.html

[39] http://reports.eea.eu.int/EMEPCORINAIR3/en

[40] Prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections (TFEIP) and published by the European Environment Agency (EEA). Copenhagen 2007. http://reports.eea.europa.eu/EMEPCORINAIR5/en/page002.html

[41] Prepared by the UNECE/EMEP Task Force on Emissions Inventories and Projections (TFEIP) and published by the European Environment Agency (EEA). Copenhagen 2009. http://www.eea.europa.eu/publications/emep-eea-emission-inventory-guidebook-2009

[42] http://reports.eea.eu.int/technical_report_2005_1/en

[43] http://reports.eea.eu.int/92-9167-033-2/en

[44] http://reports.eea.eu.int/TEC11a/en/tab_relations_RLR

Further other internationally applied methodologies and guidelines including:

- Intergovernmental Panel on Climate Change (IPCC) Guidelines
  - Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories and the IPCC Good Practice Guidance[45];
  - 2000 IPCC Good Practice Guidance (GPG) and Uncertainty Management in National Greenhouse Gas Inventories[46];
  - 2003 Good Practice Guidance for Land Use, Land-Use Change and Forestry[47];
  - 2006 IPCC Guidelines for National Greenhouse Gas Inventories[48].
- Integrated Pollution Prevention and Control (IPPC)[49] and European Pollutant Emission Register (EPER)[50];
- Guidelines for Emission Inventory Reporting from the Large Combustion Plant Directive[51];
- IPPC Best Available Techniques Reference Documents[52];
- Organization for Economic Co-operation and Development (OECD) and Pollution Release and Transfer Register (PRTR) Guidance[53].

The following table presents the main data sources used for activity data as well as information on who did the actual calculations (for unpublished studies a detailed description of the methodologies is given in this report.

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[45] http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html

[46] http://www.ipcc-nggip.iges.or.jp/public/gp/english/index.html

[47] http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html

[48] http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm

[49] http://eippcb.jrc.es/ and http://europa.eu.int/comm/environment/ippc/index.htm

[50] http://www.eper.cec.eu.int/eper/default.asp

[51] http://rod.eionet.eu.int/show.jsv?id=9&aid=500&mode=A

[52] http://eippcb.jrc.es/pages/FActivities.htm

[53] http://www.oecd.org/department/0,2688,en_2649_34411_1_1_1_1_1,00.html

Table 3: Main data sources for activity data and emission values.

Sector	Data Sources for Activity Data	Emission Calculation
Energy	● Energy balance[54]/[55] from Statistik Austria ● EU Emission Trading Scheme (ETS)[56] ● Steam boiler data base[57] administrated by Umweltbundesamt ● Data from industry und accociations[58] ● National studies	Umweltbundesamt, plant operators
Transport	● Energy balance[54] from Statistik Austria[55]	Umweltbundesamt (Aviation) Technical University Graz[59] (Road and Off-road transport)
Industry	● National production statistics from Statistik Austria ● Austrian foreign trade statistics from Statistik Austria ● EU Emission Trading Scheme (ETS)[56] ● information from industry ● information from associations of industry	Umweltbundesamt, plant operators
Solvent and Other Product Use	● Short term statistics for trade & services ● Austrian foreign trade statistics ● Structural business statistics from Statistik Austria ● Surveys at companies and associations	Umweltbundesamt, based on studies by: Forschungsinstitut für Energie u. Umweltplanung, Wirtschaft und Marktanalysen/Institut für industrielle Ökologie (IIÖ)[60]
Agriculture	● national agricultural statistics „Grüner Bericht“[61] from Statistik Austria ● national report on water protection „Gewässerschutzbericht" from Lebensministerium[62] ● national studies ● information from agricultural associations	Umweltbundesamt, based on studies by: University of Natural Resources and Applied Life Sciences[63], ARC Seibersdorf research GesmbH[64]

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[54] compatible with requirements of the International Energy Agency (IEA Joint Questionnaires)

[55] Statistik Austria (2012): Standard-Dokumentation Metainformationen (Definitionen, Erläuterungen, Methoden, Qualität) zu den Energiebilanzen für Österreich und die Bundesländer - Berichtszeitraum: 1970 – 2011 (Österreich), 1988–2011 (Bundesländer). Wien. http://www.statistik.at/web_de/statistiken/energie_und_umwelt/energie/energiebilanzen/index.html

[56] European Union Greenhouse Gas Emission Trading Scheme

[57] reporting obligation to § 10 (7) of LRG-K; data are used to verify the data from the national energy balance

[58] (1) Data are used to verify the data from the national energy balance.

(2) Activity data and relevant parameter as well as emissions for Sektor 1 B

[59] https://online.tu-graz.ac.at/tug_online/webnav.navigate_to?corg=123&cperson_nr=2416

[60] Research Institute for Energy and Environmental Planning, Economy and Market Analysis Ltd./Institute for Industrial Ecology, Austria

[61] http://www.gruenerbericht.at/cms/index.php

[62] http://www.wassernet.at/article/articleview/20149/1/5728

[63] http://www.nas.boku.ac.at

[64] http://www.systemsresearch.ac.at/index.php?cid=140

Sector	Data Sources for Activity Data	Emission Calculation
Waste	● Database on landfills (1998-2007) administrated by Umweltbundesamt, ● Electronic Data Management (EDM) (from 2008 on) administrated by LEBENSMINISTERIUM[65] ● National reports from STATISTIK AUSTRIA ● national report on water protection „Gewässerschutzbericht" from LEBENSMINISTERIUM[62]	Umweltbundesamt

Detailed information on data sources for activity and emission data or emission factors used by sector can be found in the Chapters 4–8.

For large point sources the Umweltbundesamt preferably uses – after careful assessment of plausibility of this data – emission data that are reported by the "operator" of the source because these data usually reflect the actual emissions better than data calculated using general emission factors, as the operator has the best information about the actual circumstances.

If such data is not available, national emission factors are used or, if there are no national emission factors, international emission factors are used to estimate emissions. Where no applicable data is found, standard emission factors e.g. from the EMEP/EEA air pollutant emission inventory guidebook 2009 are applied.

Table 4 presents the methods applied and the origin of emission factors used for the categories in the NFR format for the present Austrian inventory.

For key source categories (see Chapter 1.4) the most accurate methods for the preparation of the air emission inventory should be used. Required methodological changes and planned improvements are described in the corresponding sector analysis chapters (Chapters 4–8).

Main Data Suppliers

- The main data supplier for the Austrian Air Emission Inventory is *STATISTIK AUSTRIA*[66], providing the underlying energy source data. The Austrian energy balances are based on several databases mainly prepared by the Federal Ministry of Economy, Family and Youth[67], "Bundeslastverteiler" and Statistik Austria. Their methodology follows the Energy Agency (IEA)[68] and Eurostat[69] conventions. The aggregated balances, for example transformation input and output or final energy use, are harmonised with the IEA tables as well as their sectoral breakdown which follows the NACE[70] classification.
- Information about activity data and emissions of the industry sector is obtained from *Association of the Austrian Industries*[71] or directly from individual plants. If emission data are reported (e.g. by the plant owner) this data is – after assessment of plausibility – taken over into the inventory. Activity data for some sources are obtained from Statistik Austria which provides statistics on production data[72]. The methodology of the statistics changed in 1996, no data

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[65] https://secure.umweltbundesamt.at/edm_portal/home.do?wfjs_enabled=true&wfjs_orig_req=/home.do

[66] www.statistik.at

[67] Bundesministerium für Wirtschaft und Arbeit (BMWA); www.bmwa.gv.at

[68] http://www.iea.org/

[69] www.europa.eu.int/comm/eurostat/

[70] Classification of Economic Activities in the European Community

[71] Mainly organized in the Austrian Federal Economic Chamber; http://portal.wko.at/wk/startseite.wk

[72] "Industrie und Gewerbestatistik" published by STATISTIK AUSTRIA for the years until 1995; "Konjunkturstatistik im produzierenden Bereich" published by STATISTIK AUSTRIA for the years 1997 to 2006.

are available for that year and there are some product groups no longer reported in the new statistics.

- Operators of steam boilers with more than 50 MW report their emissions (e. g. NO_x, SO_2, CO and TSP) and their activity data directly to the to the steam boiler data base[57] (Dampfkesseldatenbank) administrated by the Umweltbundesamt.
- Data from national and sometimes international studies are also used.
- Until 2008, operators of landfill sites reported their activity data directly to the Austrian Ministry of Environment or the Umweltbundesamt, where they were – after a check – in turn incorporated into a database on landfills. Emissions for the years 1998–2007 are calculated on basis of these data. Since 2009 landfill operators have to register and report their waste input directly at the portal of the Electronic Data Mangement. These data are evaluated by the responsible body at federal level (BMLFUW) and are made available for emission calculation. This was done for reporting year 2008 for the first time.
- Activity data needed for the calculation of non-energetic emissions are based on several statistics collected by Statistik Austria and national and international studies.
- Activity data for Solvent and Other Product Use are based on import/export statistics also prepared by STATISTIK AUSTRIA.

Data from the EU Emission trading Scheme

The European Emissions Trading Scheme (EU-ETS) has been established by Directive 2003/87/EC of the European Parliament and of the Council[73]. It includes heavy energy-consuming installations in power generation and manufacturing. The activities covered are energy activities, the production and processing of ferrous metals, the mineral industry and some other production activities. Since 2012 CO_2 emissions from aviation have also been included. For the trading period 2013-2020 the scope of the EU ETS has been further extended to include additional installations from the metal and chemical industry and compressor stations. For more detailed information on the included activities please refer to Annex I of the above mentioned directive.

At the moment, the greenhouse gases covered under the EU-ETS in Austria are CO_2 (since 2005) and N_2O (since 2010).[74] However, other greenhouse gases and activities will be included in the scope of the EU-ETS from 2013 onwards. About one third of total Austrian GHG emissions currently result from installations under the EU-ETS (~31 Tg CO_2 in 2011).

Plant operators have to report their activity data and CO_2 emissions annually; for the first time they reported their emissions of 2005 in March 2006. The first trading period of the EU-ETS ran from 2005–2007. The second trading period, which coincided with the 1st Kyoto commitment period, ran from 2008-2012 and the third trading period, which coincides with the 2nd Kyoto commitment period, will run from 2013-2020.

An important feature of the activity data and CO_2 emissions reported under the EU-ETS is that these emissions have to pass independent verification. The Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management is in charge of granting the licence to independent verifiers. In addition, the Ministry has to fulfil a quality control function, which is implemented by the Umweltbundesamt on behalf of the Ministry.

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[73] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC, OJ L 275/32

[74] Austria unilaterally opted-in N_2O as of 2010. Since 2013 N_2O and PFCs have been included in the EU ETS at EU level.

Data from EPER/E-PRTR

The European Pollutant Emission Register (EPER) was the first Europe-wide register for emissions from industrial facilities both into air and water. The legal basis of EPER is Article 15 of the IPPC Directive (EPER Decision 2000/479/EG)[75], which stipulates that information on environmental pollution has to be provided to the public[76]. EPER was replaced by the European Pollutant Release and Transfer Register (E-PRTR) in 2007, which was established by the E-PRTR Regulation (EC) No 166/2006[77].

EPER covered 50 pollutants, including CO_2, CH_4, N_2O, SF_6 and PFCs from six activity groups. Under EPER Austrian industrial facilities had to report their annual emissions of 2001 or 2002 and 2004. There were about 400 facilities in Austria that had to report to EPER. As the thresholds for reporting emissions are relatively high, only about 130 facilities reported emissions.

E-PRTR is an extension of EPER and covers 91 pollutants from nine activity groups, including all pollutants reported already under EPER. Again, emissions only have to be reported if they exceed certain thresholds. In contrast to EPER, E-PRTR also included data on releases into soil, accidental releases, waste transfers and diffuse emissions.

The Umweltbundesamt implemented E-PRTR in Austria using an electronic system enabling the facilities and the authorities to fulfil the requirements of the E-PRTR Regulation electronically via the internet. In 2008, installations reported for the first time releases and transfers of pollutants from 2007 under E-PRTR, which is an annual reporting obligation. The plausibility of the reports is checked by the competent authorities and the Umweltbundesamt. The Umweltbundesamt also checks the data for consistency with the national inventory.

Data from EPER/E-PRTR has so far not been used as a data source for the national inventory. On the one hand, this is due to the high reporting thresholds. On the other hand, the EPER/E-PRTR reports contain only very little information other than emission data. Concerning methodology the only information included is whether emissions are estimated, measured or calculated. For activity data facilities report one value that is often not useful in the context of emissions and may be different between producers of the same product.

In addition, EPER/E-PRTR data is not complete for IPCC sectors and it is difficult to include this point source information because no background information (such as fuel consumption data) is available.

Thus the top-down approach of the national inventory has been considered more reliable and data of EPER/E-PRTR has not been used as point source data for the national inventory, but for verification purposes only where plausible.

LITERATURE

National and sometimes international studies are also used as data suppliers (references are given in the sector analysis chapters).

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[75] http://www.umweltbundesamt.at/fileadmin/site/daten/EPER/EPER_Entscheidung_EK.pdf

[76] Data can be downloaded from: http://www.umweltbundesamt.at/umweltdaten/datenbanken10/eper/

[77] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:033:0001:0017:EN:PDF

Studies on HM, POPs and PM emissions

Emissions of HM and some POPs have already been estimated in the course of CORINAIR 1990 and 1994, respectively[78]. With these data and other Austrian publications as a basis comprehensive emission inventories of HM, POPs and PM for different years were prepared by contractors of the Umweltbundesamt and incorporated into the inventory system afterwards.

- WINDSPERGER, A. et. al. (1999): Entwicklung der Schwermetallemissionen – Abschätzung der Emissionen von Blei, Cadmium und Quecksilber für die Jahre 1985, 1990 und 1995 gemäß der CORINAIR-Systematik. Institut für Industrielle Ökologie und Österreichisches Forschungszentrum Seibersdorf. Wien. (Nicht veröffentlicht).

  Development of Heavy Metal Emissions – Estimation of emissions of Lead, Cadmium and Mercury for the years 1985, 1990 and 1995 according to the CORINAIR-systematics. Department for industrial ecology *and Austrian Research Centers Seibersdorf. Vienna. (not published).*

- Österreichische Emissionsinventur für Cadmium, Quecksilber und Blei.

  Austrian emission inventory for Cd, Hg and Pb 1995–2000 prepared by FTU – Forschungsgesellschaft Technischer Umweltschutz GmbH. Vienna November 2001 (not published).

- HÜBNER, C. (2001): Österreichische Emissionsinventur für POPs 1985–1999. FTU – Forschungsgesellschaft Technischer Umweltschutz GmbH. Werkvertrag des Umweltbundesamt, IB-650. Wien. (Nicht veröffentlicht).

  Austrian emission inventory for POPs 1985–1999. Prepared by FTU – Research Center Technical environment protection (Ltd.). Study commissioned by Umweltbundesamt IB-650. Vienna. (not published).

- WINIWARTER, W.; TRENKER, C.; HÖFLINGER, W. (2001): Österreichische Emissionsinventur für Staub. Österreichisches Forschungszentrum Seibersdorf. Wien.

  Austrian emission inventory for PM. Austrian Research Centers Seibersdorf. Vienna.

- WINIWARTER, W.; SCHMID-STEJSKAL, H. & WINDSPERGER, A. (2007): Aktualisierung und Verbesserung der österreischen Luftschadstoffinventur für Schwebstaub. Systems research – Austrian Research Centers & Institut für Industrielle Ökologie. Wien.

  Updating and Improvement of the Austrian Air Emission Inventory (OLI) for PM. Systems research – Austrian Research Centers & Department for industrial ecology. Vienna.

Summary of methodologies applied for estimating emissions

In Table 4 a summary of methodologies applied for estimating emissions is given.

The following abbreviations are used:

- D DEFAULT
- L Literature
- CS COUNTRY SPECIFIC
- PS PLANT SPECIFIC

Dark shaded cells indicate that no such emissions arise from this source; light shaded cells (green) indicate key sources.

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[78] ORTHOFER, R. (1996); HÜBNER, C. (1996); HÜBNER, C. & WURST, F. (1997); HÜBNER, C. (2000)

Table 4: Summary of methodologies applied for estimating emissions.

NFR	Description	SO_2	NO_x	NMVOC	NH_3	CO	Cd	Hg	Pb	PAH	Diox	HCB	TSP	PM10	PM2.5
1 A 1 a	Public Electricity and Heat Production	PS, CS	PS, CS	CS	CS	PS, CS	D/CS	D/CS	D/CS	L/CS	L/CS	L/CS	PS, CS	PS, CS	PS, CS
1 A 1 b	Petroleum refining	PS	PS		CS	PS	CS	CS	CS	L/CS	L/CS	CS	PS	PS	PS
1 A 1 c	Manufac.of Solid fuels a. Oth. Energy Ind.		CS	CS	CS	CS					L/CS	CS	CS	CS	CS
1 A 2 mobile	Other mobile in industry	CS	CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS	CS	CS	CS
1 A 2 stat (l)	Manuf. Ind. & Constr. stationary LIQUID	PS, CS	PS, CS	PS, CS	CS	PS, CS	D/CS	D/CS	D/CS	L/CS	L/CS	CS	PS, CS	PS, CS	PS, CS
1 A 3 a	Civil Aviation	CS	CS	CS	CS	CS	CS	CS	CS				CS	CS	CS
1 A 3 b 1	R.T., Passenger cars	CS	CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS	CS	CS	CS
1 A 3 b 2	R.T., Light duty vehicles	CS	CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS	CS	CS	CS
1 A 3 b 3	R.T., Heavy duty vehicles	CS	CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS	CS	CS	CS
1 A 3 b 4	R.T., Mopeds & Motorcycles		CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS			
1 A 3 b 5	R.T., Gasoline evaporation			CS											
1 A 3 b 6	R.T., Automobile tyre and break wear						L						CS	CS	CS
1 A 3 c	Railways	CS	CS	CS	CS	CS	D/CS	D/CS	D/CS	L/CS	L/CS	CS	CS	CS	CS
1 A 3 d	Navigation	CS	CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS	CS	CS	CS
1 A 3 e	Other	NA	CS	CS	CS	CS						CS	CS	CS	CS
1 A 4 mob	Other Sectors – mobile	CS	CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS	CS	CS	CS
1 A 4 stat (b)	Other Sectors stationary BIOMASS	CS	CS	CS	CS	CS	D/CS	D/CS	D/CS	L/CS	L/CS	CS	CS	CS	CS
1 A 5	Other	CS	CS	CS	CS	CS	CS	CS	CS	L/CS	L/CS	CS	CS	CS	CS

NFR	Description	SO_2	NO_x	NMVOC	NH_3	CO	Cd	Hg	Pb	PAH	Diox	HCB	TSP	PM10	PM2.5
1 B	FUGITIVE EMISSIONS FROM FUELS	PS		D, PS									CS	CS	CS
2 A	MINERAL PRODUCTS					L							CS	CS	CS
2 B	CHEMICAL INDUSTRY	CS	CS	CS	PS	CS	CS	CS	CS				CS	CS	CS
2 C	METAL PRODUCTION	CS	CS	CS		CS	CS	CS	CS	CS	CS	CS	CS	CS	CS
2 D	OTHER PRODUCTION		CS	L		CS				CS	CS	CS	CS	CS	CS
2 G	OTHER				CS										
3	SOLVEN & OTHER PRODUCT USE			CS			PS		CS						
4 B 1	Cattle				CS										
4 B 3	Sheep				D										
4 B 4	Goats				D										
4 B 6	Horses				D										
4 B 8	Swine				CS										
4 B 9	Poultry				D										
4 B-13	Other				D										
4 D	AGRICULTURAL SOILS		D	D	D								L	L	L
4 F	FIELD BURNING OF AGRIC. RESIDUES	CS/D	CS/D	CS/D	CS/D	CS/D	CS/D	CS/D	CS/D	CS/D	CS/D	CS/D			
4 G	Agriculture – Other												D	D	D
6	WASTE	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS

1.4 Key Category Analysis

The identification of key categories is described in the "Good Practice Guidance for LRTAP Emission Inventories" (see Chapter 2 of the EMEP/EEA emission inventory guidebook 2009 and IPCC Good Practice Guidance (IPCC-GPG, 2000), Chapter 7). It stipulates that a key category is one that is prioritised within the National System because its estimate has a significant influence on a country's total inventory of air emission inventory in terms of the absolute level of emissions, the trend in emissions, or both.

As stated in the "Good Practice Guidance for LRTAP Emission Inventories", it is good practice

- to identify the national key categories in a systematic and objective manner. This can be achieved by a quantitative analysis of the relationship between the magnitude of emission in any one year (level) and the change in emission year to year (trend) of each category's emissions compared to the total national emissions;
- to choose the parameter which is considered as key also depends on the application of the inventory:
  - for compliance assessments the trend is essential, whereas
  - in the case that emission reporting obligations are formulated as emission ceilings, the emission level uncertainty is relevant.

All notations, descriptions of identification and results for key categories included in this chapter are based on the Good Practice Guidance.

The identification includes all NFR categories and all reported gases

- SO_2, NO_x, NMVOC, NH_3, CO
- PM: TSP, PM10, PM2.5
- HM: Cd, Hg, Pb
- POP: PAH, PCDD/F, HCB.

Methodology – Approach 1

The methodology follows the IPCC approach to produce pollutant-specific key categories and covers for both level and trend assessments. In Approach 1, key categories are identified using a predetermined cumulative emissions threshold. Key categories are those which, when summed together in descending order of magnitude, cumulatively add up to 80% of the total level.

Identification of Source Categories

This is an important step in terms of correlation of input data, which could otherwise falsify results of a key category analysis which usually assumes that input data are not dependent on each other.

A very detailed analysis e.g. on the level of detail given in the NFR might result in many categories with the same source of (correlating) input data, whereas on the other hand a high level of aggregation could mask some information.

For the first time the suggested aggregation level of analysis for Approach 1 provided in Table 2-1 of Chapter 2 of the EMEP/EEA emission inventory guidebook 2009 was used. No special considerations like disaggregation to main fuel types have been made.

For reasons of transparency, the same level of aggregation for all pollutants was used.

The presented key category analysis was performed by the Umweltbundesamt with data for air emissions of the submission 2012 to the UNECE/LRTAP and comprises for all gases a level assessment for all years between 1990 and 2011 and a trend assessment for 1990 to 2011.

1 A Combustion Activities

1 A Combustion Activities is the most important sector for emissions reported to UNECE. To account for this fact and help prioritising efforts this sector was analysed in greater detail.

Furthermore, for mobile sources the different means of transport were considered separately, and additionally the sub category road transport was further disaggregated as it is an important source for many pollutants.

For stationary sources a split following the third level of the NFR was used (1 A 2, 1 A 4).

NFR	Description	NFR	Description
1 A 1 a	Public Electricity and Heat Production	1 A 3 a	Civil Aviation
1 A 1 b	Petroleum refining	1 A 3 b 1	R.T., Passenger cars
1 A 1 c	Manufacture of Solid fuels and Other Energy Industries	1 A 3 b 2	R.T., Light duty vehicles
1 A 2 a	Iron and Steel	1 A 3 b 3	R.T., Heavy duty vehicles
1 A 2 b	Non-ferrous Metals	1 A 3 b 4	R.T., Mopeds & Motorcycles
1 A 2 c	Chemicals	1 A 3 b 5	R.T., Gasoline evaporation
1 A 2 d	Pulp, Paper and Print	1 A 3 b 6	R.T., Automobile tyre and break wear
1 A 2 e	Food Processing, Beverages and Tobacco		
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	1 A 3 b 7	R.T., Automobile road abrasion
1 A 2 f 2	Mobile Combustion in Manufacturing Industries and Construction: Other	1 A 3 c	Railways
1 A 4 a 1	Commercial/Institutional: Stationary	1 A 3 d	Navigation
1 A 4 a 2	Commercial/Institutional: Mobile	1 A 3 e	Pipeline compressors
1 A 4 b 1	Residential: stationary	1 A 5 a	Other, Stationary (including Military)
1 A 4 b 2	Residential: Household and gardening (mobile)	1 A 5 b	Other, Mobile (including Military)
1 A 4 c 1	Agriculture/Forestry/Fishing: Stationary		
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery		
1 A 4 c 3	Agriculture/Forestry/Fishing: National Fishing		

1 B Fugitive Emission

For fugitive emissions a split following the third level of the NFR was used.

NFR	Description	NFR	Description
1 B 1 a	Coal Mining and Handling	1 B 2 a	Oil
1 B 1 b	Solid fuel transformation	1 B 2 b	Natural gas
1 B 1 c	Other	1 B 2 c	Venting and flaring

2 Industrial Processes

For sources categories from Industrial procecces a split following the third level of the NFR was used, for sources categories 2 A 7 even the fourth level. For sources categories NFR 2 E – NFR 2 G level two of the NFR was used.

NFR	**Description**	**NFR**	**Description**
2 A 1	Cement Production	2 C 1	Iron and Steel Production
2 A 2	Lime Production	2 C 2	Ferroalloys Production
2 A 3	Limestone and Dolomite Use	2 C 3	Aluminium production
2 A 4	Soda Ash Production and use	2 C 5	Other metal production
2 A 5	Asphalt Roofing	2 D 1	Pulp and Paper
2 A 6	Road Paving with Asphalt	2 D 2	Food and Drink
2 A 7 a	Quarrying and mining of minerals other than coal	2 D 3	Wood processing
2 A 7 b	Construction and demolition	2 E	Production of POPs
2 A 7 c	Storage, handling and transport of mineral products	2 F	Consumption of POPs and Heavy Metals (e.g. electricial and scientific equipment)
2 A 7 d	Other Mineral products (Please specify)		
2 B 1	Ammonia Production	2 G	2 G Other production, consumption, storage, transp. or handling of bulk products
2 B 2	Nitric Acid Production		
2 B 3	Adipic Acid Production	2 E	Production of POPs
2 B 4	Carbide Production		
2 B 5	Other		

3 Solvent and Other Product Use

Level two of the NFR was used.

NFR	**Description**	**NFR**	**Description**
3 A	PAINT APPLICATION	3 C	3 C Chemical products
3 B	DEGREASING AND DRY CLEANING	3 D	OTHER including products containing HMs and POPs

4 Agriculture

Level two of the NFR was used; only the sub category 4 B was further disaggregated as this is an important source for NH3 and the methodology is different for the animal categories.

NFR	Description	NFR	Description
4 B 1	Cattle	4 C	RICE CULTIVATION
4 B 2	Buffalo	4 D 1	Direct Soil Emissions
4 B 3	Sheep	4 D 2	Soil operations
4 B 4	Goats	4 F	FIELD BURNING OF AGRICULTURAL RESIDUES
4 B 5	Camels and Llamas	4 G	Agriculture OTHER
4 B 6	Horses		
4 B 7	Mules and Asses		
4 B 8	Swine		
4 B 9	Poultry		
4 B-13	Other		

6 Waste

Level two of the NFR was used.

NFR	Description	NFR	Description
6 A	SOLID WASTE DISPOSAL ON LAND	6 C	WASTE INCINERATION
6 B	WASTEWATER HANDLING	6 D	OTHER WASTE

Results of the Level and Trend Assessment

As the analysis was made for all different pollutants reported to the UNECE and as these pollutants differ in their way of formation, most of the identified categories are key for one pollutant or more: as in last year's analysis, 36 key sources were identified.

Table 5: Summary of Key Categories for the year 2011 – Level and Trend Assessment as well as Rank.

NFR Code	NFR Category	SO_2		NO_X		NMVOC		NH_3		CO		Cd		Pb		Hg		PAH		DIOX		HCB		TSP		PM10		PM2.5		Number	Rank
		LA[79]	TA[80]	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA		
1 A 1 a	Public Electricity and Heat Production	3		4								3	3	2	3	2	4									9		7	6	***11***	***4***
1 A 1 b	Petroleum refining				5							4	2																	***3***	***16***
1 A 2 a	Iron and Steel	1	2							2	3																			***4***	***13***
1 A 2 b	Non-ferrous Metals												5	5						5	2		1							***5***	***11***
1 A 2 d	Pulp, Paper and Print	5										6															11		9	***4***	***13***
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	2	3	3						5	6	5		4	5	3	2			2	5			6	5	5	3	2	1	***18***	***2***
1 A 2 f 2	Mobile Combustion in Manufacturing Industries and Construction: Other			7	3																			7	6	10	10	9		***7***	***8***
1 A 3 b 1	R.T., Passenger cars			2	2	5	2		2	3	1				1			3	3							7	6	3	4	***14***	***3***
1 A 3 b 2	R.T., Light duty vehicles				7		7				4																			***3***	***16***
1 A 3 b 3	R.T., Heavy duty vehicles		5	1	1													2	2						9		8	8	8	***9***	***6***
1 A 3 b 4	R.T., Mopeds & Motorcycles									4	5																			***2***	***22***
1 A 3 b 5	R.T., Gasoline evaporation						3																							***1***	***30***
1 A 3 b 7	R.T., Automobile road abrasion												4											2	2	4	4	6	7	***7***	***8***
1 A 3 c	Railways																							8					11	***2***	***22***
1 A 4 a 1	Commercial/Institutional: Stationary		4										7																10	***3***	***16***
1 A 4 b 1	Residential: stationary	4	1	5	6	2				1	2	2		3	4	4		1	1	1	1	1	2	4	3	1	2	1	3	***23***	***1***

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[79] LA Level Assesment

[80] TA Trend Assesment

NFR Code	NFR Category	SO_2		NO_X		NMVOC		NH_3		CO		Cd		Pb		Hg		PAH		DIOX		HCB		TSP		PM10		PM2.5		Number	Rank
		LA[79]	TA[80]	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA	LA	TA		
1 A 4 b 2	Residential: Household and gardening (mobile)									6																				***1***	***30***
1 A 4 c 1	Agricul-ture/Forestry/Fishing: Stationary										7							4	4	4		2	3							***6***	***10***
1 A 4 c 2	Agricuture/Forestry/ Fishing: Off-road Vehicles and Other Machinery			6		7																		9	8	8	7	4	5	***8***	***7***
1 B 2 a	Oil						4																							***1***	***30***
2 A 7 a	Quarrying and mining of minerals other than coal																							3	4	3	5	10		***5***	***11***
2 A 7 b	Construction and demolition																							5	7	6	9			***4***	***13***
2 B 5	Other				4		6										3													***3***	***16***
2 C 1	Iron and Steel Production											1	1	1	2	1	1			3	3				1		1		2	***11***	***4***
2 D 2	Food and Drink						8												5											***2***	***22***
3 A	PAINT APPLICATION					3																								***1***	***30***
3 B	DEGREASING AND DRY CLEANING					4	5																							***2***	***22***
3 C	3 C Chemical products					6																								***1***	***30***
3 D	OTHER including products containing HMs and POPs					1	1																					11		***3***	***16***
4 B 1	Cattle							1	4																					***2***	***22***
4 B 8	Swine							2	1																					***2***	***22***
4 B 9	Poultry							3	6																					***2***	***22***
4 D 1	Direct Soil Emissions								5																					***1***	***30***
4 D 2	Soil operations																							1		2		5		***3***	***16***
6 C	WASTE INCINERATION												6								4									***2***	***22***
6 D	OTHER WASTE								3																					***1***	***30***

Table 6: Key Categories for SO_2 gases for the year 2011.

Level Assessment				
NFR Code	**NFR Category**	**Latest Year (2011) Estimate [Gg] $E_{x,t}$**	**Level Assessment $L_{x,t}$**	**Cumulative Total of $L_{x,t}$**
1 A 2 a	Iron and Steel	5.10	27.5%	27.5%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	4.28	23.1%	50.7%
1 A 1 a	Public Electricity and Heat Production	2.52	13.6%	64.3%
1 A 4 b 1	Residential: stationary	1.92	10.4%	74.7%
1 A 2 d	Pulp, Paper and Print	1.09	5.9%	80.6%
	National Total	**18.51**		

Trend Assessment						
NFR Code	**NFR Category**	**'Base Year' (1990) Estimate [Gg] $E_{x,0}$**	**Latest Year (2011) Estimate [Gg] $E_{x,t}$**	**Trend Assessment $L_{x,t}$**	**Contribution to the trend**	**Cumulative Total of $L_{x,t}$**
1 A 4 b 1	Residential: stationary	25.87	1.92	0.979	28.5%	28.5%
1 A 2 a	Iron and Steel	6.73	5.10	0.745	21.7%	50.2%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	4.18	4.28	0.705	20.5%	70.7%
1 A 4 a 1	Commercial/Institutional: Stationary	5.23	0.34	0.209	6.1%	76.8%
1 A 3 b 3	R.T., Heavy duty vehicles	2.61	0.05	0.130	3.8%	80.6%
	National Total	**74.45**	**18.51**			

Table 7: Key Categories for NO_x gases for the year 2011.

Level Assessment

NFR Code	NFR Category	Latest Year (2011) Estimate [Gg] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
1 A 3 b 3	R.T., Heavy duty vehicles	62.16	34.0%	34.0%
1 A 3 b 1	R.T., Passenger cars	35.26	19.3%	53.3%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	12.94	7.1%	60.4%
1 A 1 a	Public Electricity and Heat Production	11.06	6.1%	66.4%
1 A 4 b 1	Residential: stationary	10.21	5.6%	72.0%
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	7.74	4.2%	76.3%
1 A 2 f 2	Mobile Combustion in Manufacturing Industries and Construction: Other	7.67	4.2%	80.5%
	National Total	**182.71**		

Trend Assessment

NFR Code	NFR Category	'Base Year' (1990) Estimate [Gg] $E_{x,0}$	Latest Year (2011) Estimate [Gg] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
1 A 3 b 3	R.T., Heavy duty vehicles	49.04	62.16	0.096	33.8%	49.04
1 A 3 b 1	R.T., Passenger cars	45.31	35.26	0.042	14.7%	45.31
1 A 2 f 2	Mobile Combustion in Manufacturing Industries and Construction: Other	3.03	7.67	0.028	10.0%	3.03
2 B 5	Other	4.07	0.08	0.022	7.7%	4.07
1 A 1 b	Petroleum refining	4.32	0.90	0.018	6.5%	4.32
1 A 4 b 1	Residential: stationary	13.08	10.21	0.012	4.2%	13.08
1 A 3 b 2	R.T., Light duty vehicles	7.78	5.66	0.009	3.3%	7.78
1 A 3 b 3	R.T., Heavy duty vehicles	49.04	62.16	0.096	33.8%	49.04
	National Total	**195.47**	**182.71**			

Table 8: Key Categories for NMVOC gases for the year 2011.

Level Assessment

NFR Code	NFR Category	Latest Year (2011) Estimate [Gg] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
3 D	OTHER including products containing HMs and POPs	36.05	28.1%	28.1%
1 A 4 b 1	Residential: stationary	23.10	18.0%	46.2%
3 A	PAINT APPLICATION	20.36	15.9%	62.0%
3 B	DEGREASING AND DRY CLEANING	9.96	7.8%	69.8%
1 A 3 b 1	R.T., Passenger cars	6.27	4.9%	74.7%
3 C	Chemical products	6.15	4.8%	79.5%
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	3.26	2.5%	82.0%
	National Total	**128.17**		

Trend Assessment

NFR Code	NFR Category	'Base Year' (1990) Estimate [Gg] $E_{x,0}$	Latest Year (2011) Estimate [Gg] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
3 D	OTHER including products containing HMs and POPs	42.15	36.05	0.272	26.7%	26.7%
1 A 3 b 1	R.T., Passenger cars	40.64	6.27	0.213	20.9%	47.6%
1 A 3 b 5	R.T., Gasoline evaporation	19.19	1.96	0.117	11.5%	59.1%
1 B 2 a	Oil	12.10	1.91	0.063	6.1%	65.2%
3 B	DEGREASING AND DRY CLEANING	13.70	9.96	0.059	5.8%	71.0%
2 B 5	Other	8.29	1.32	0.043	4.2%	75.2%
1 A 3 b 2	R.T., Light duty vehicles	4.05	0.30	0.027	2.6%	77.8%
2 D 2	Food and Drink	1.89	2.39	0.025	2.5%	80.3%
	National Total	**273. 84**	**128.17**			

Table 9: Key Categories for NH_3 gases for the year 2011.

Level Assessment

NFR Code	NFR Category	Latest Year (2011) Estimate [Gg] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
4 B 1	Cattle	34.91	56.0%	56.0%
4 B 8	Swine	10.90	17.5%	73.5%
4 B 9	Poultry	5.82	9.3%	82.8%
	National Total	**62.33**		

Trend Assessment

NFR Code	NFR Category	'Base Year' (1990) Estimate [Gg] $E_{x,0}$	Latest Year (2011) Estimate [Gg] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
4 B 8	Swine	13.52	10.90	0.033	24.1%	24.1%
1 A 3 b 1	R.T., Passenger cars	2.71	1.00	0.027	19.3%	43.4%
6 D	OTHER WASTE	0.35	1.39	0.018	12.8%	56.3%
4 B 1	Cattle	35.68	34.91	0.015	10.9%	67.1%
4 D 1	Direct Soil Emissions	3.77	4.36	0.013	9.3%	76.5%
4 B 9	Poultry	5.49	5.82	0.010	7.1%	83.6%
	National Total	**65.39**	**62.33**			

Table 10: Key Categories for CO gases for the year 2011.

Level Assessment

NFR Code	NFR Category	Latest Year (2011) Estimate [Gg] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
1 A 4 b 1	Residential: stationary	221.38	36.4%	36.4%
1 A 2 a	Iron and Steel	120.85	19.9%	56.2%
1 A 3 b 1	R.T., Passenger cars	100.14	16.5%	72.7%
1 A 3 b 4	R.T., Mopeds & Motorcycles	22.08	3.6%	76.3%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	21.35	3.5%	79.8%
1 A 4 b 2	Residential: Household and gardening (mobile)	16.80	2.8%	82.6%
	National Total	**608.77**		

Trend Assessment

NFR Code	NFR Category	'Base Year' (1990) Estimate [Gg] $E_{x,0}$	Latest Year (2011) Estimate [Gg] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
1 A 3 b 1	R.T., Passenger cars	569.65	100.14	0.548	40.8%	40.8%
1 A 4 b 1	Residential: stationary	416.26	221.38	0.174	13.0%	53.8%
1 A 2 a	Iron and Steel	210.72	120.85	0.122	9.1%	62.9%
1 A 3 b 2	R.T., Light duty vehicles	59.66	3.44	0.085	6.3%	69.2%
1 A 3 b 4	R.T., Mopeds & Motorcycles	10.22	22.08	0.069	5.1%	74.3%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	11.07	21.35	0.065	4.8%	79.1%
1 A 4 c 1	Agriculture/Forestry/Fishing: Stationary	12.75	14.74	0.036	2.7%	81.8%
	National Total	**1 436.40**	**608.77**			

Table 11: Key Categories for Cd gases for the year 2011.

Level Assessment

NFR Code	NFR Category	Latest Year (2011) Estimate [Mg] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
2 C 1	Iron and Steel Production	0.23	19.8%	19.8%
1 A 4 b 1	Residential: stationary	0.21	18.2%	38.0%
1 A 1 a	Public Electricity and Heat Production	0.15	13.2%	51.2%
1 A 1 b	Petroleum refining	0.15	12.5%	63.7%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	0.11	9.1%	72.8%
1 A 2 d	Pulp, Paper and Print	0.10	8.6%	81.4%
	National Total	**1.16**		

Trend Assessment

NFR Code	NFR Category	'Base Year' (1990) Estimate [Mg] $E_{x,0}$	Latest Year (2011) Estimate [Mg] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
2 C 1	Iron and Steel Production	0.46	0.23	0.123	20.5%	20.5%
1 A 1 b	Petroleum refining	0.09	0.15	0.093	15.4%	35.9%
1 A 1 a	Public Electricity and Heat Production	0.10	0.15	0.091	15.2%	51.1%
1 A 3 b 7	R.T., Automobile road abrasion	0.06	0.09	0.060	10.0%	61.0%
1 A 2 b	Non-ferrous Metals	0.08	0.02	0.053	8.9%	69.9%
6 C	WASTE INCINERATION	0.06	0.00	0.050	8.3%	78.2%
1 A 4 a 1	Commercial/Institutional: Stationary	0.07	0.02	0.038	6.4%	84.6%
	National Total	**1.58**	**1.16**			

Table 12: Key Categories for Pb gases for the year 2011.

Level Assessment

NFR Code	NFR Category	Latest Year (2011) Estimate [g] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
2 C 1	Iron and Steel Production	6.86	44.5%	44.5%
1 A 1 a	Public Electricity and Heat Production	2.20	14.3%	58.7%
1 A 4 b 1	Residential: stationary	1.72	11.2%	69.9%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	1.53	9.9%	79.8%
1 A 2 b	Non-ferrous Metals	1.05	6.8%	86.7%
	National Total	**15.42**		

Trend Assessment

NFR Code	NFR Category	'Base Year' (1990) Estimate [g] $E_{x,0}$	Latest Year (2011) Estimate [g] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
1 A 3 b 1	R.T., Passenger cars	146.94	0.01	9.522	42.8%	42.8%
2 C 1	Iron and Steel Production	32.09	6.86	4.236	19.0%	61.8%
1 A 1 a	Public Electricity and Heat Production	0.90	2.20	1.966	8.8%	70.7%
1 A 4 b 1	Residential: stationary	3.82	1.72	1.338	6.0%	76.7%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	4.40	1.53	1.124	5.0%	81.7%
	National Total	**218.96**	**15.42**			

Table 13: Key Categories for Hg gases for the year 2011.

Level Assessment

NFR Code	NFR Category	Latest Year (2011) Estimate [kg] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
2 C 1	Iron and Steel Production	0.32	32.3%	32.3%
1 A 1 a	Public Electricity and Heat Production	0.20	20.3%	52.7%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	0.19	18.6%	71.2%
1 A 4 b 1	Residential: stationary	0.14	14.1%	85.3%
	National Total	**1.00**		

Trend Assessment

NFR Code	NFR Category	‘Base Year‘ (1990) Estimate [kg] $E_{x,0}$	Latest Year (2011) Estimate [kg] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
2 C 1	Iron and Steel Production	0.26	0.32	0.434	31.5%	31.5%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	0.71	0.19	0.313	22.7%	54.2%
2 B 5	Other	0.27	0.00	0.269	19.5%	73.8%
1 A 1 a	Public Electricity and Heat Production	0.33	0.20	0.108	7.8%	81.6%
	National Total	**2.14**	**1.00**			

Table 14: Key Categories for PAH gases for the year 2011.

Level Assessment				
NFR Code	**NFR Category**	**Latest Year (2011) Estimate [Mg] $E_{x,t}$**	**Level Assessment $L_{x,t}$**	**Cumulative Total of $L_{x,t}$**
1 A 4 b 1	Residential: stationary	4.08	58.0%	58.0%
1 A 3 b 3	R.T., Heavy duty vehicles	0.68	9.7%	67.7%
1 A 3 b 1	R.T., Passenger cars	0.68	9.7%	77.4%
1 A 4 c 1	Agriculture/Forestry/Fishing: Stationary	0.54	7.7%	85.1%
	National Total	**7.03**		

Trend Assessment						
NFR Code	**NFR Category**	**'Base Year' (1990) Estimate [Mg] $E_{x,0}$**	**Latest Year (2011) Estimate [Mg] $E_{x,t}$**	**Trend Assessment $L_{x,t}$**	**Contribution to the trend**	**Cumulative Total of $L_{x,t}$**
1 A 4 b 1	Residential: stationary	7.92	4.08	0.270	26.5%	26.5%
1 A 3 b 3	R.T., Heavy duty vehicles	0.28	0.68	0.194	19.0%	45.5%
1 A 3 b 1	R.T., Passenger cars	0.50	0.68	0.163	16.0%	61.5%
1 A 4 c 1	Agriculture/Forestry/Fishing: Stationary	0.35	0.54	0.134	13.2%	74.7%
2 D 2	Food and Drink	0.55	0.04	0.065	6.4%	81.1%
	National Total	**16.92**	**7.03**			

Table 15: Key Categories for PCDD/F/Furan gases for the year 2011.

Level Assessment

NFR Code	NFR Category	Latest Year (2011) Estimate [g] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
1 A 4 b 1	Residential: stationary	18.73	52.8%	52.8%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	3.42	9.6%	62.5%
2 C 1	Iron and Steel Production	3.02	8.5%	71.0%
1 A 4 c 1	Agriculture/Forestry/Fishing: Stationary	2.42	6.8%	77.8%
1 A 2 b	Non-ferrous Metals	2.22	6.3%	84.1%
	National Total	**35.45**		

Trend Assessment

NFR Code	NFR Category	'Base Year' (1990) Estimate [g] $E_{x,0}$	Latest Year (2011) Estimate [g] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
1 A 4 b 1	Residential: stationary	41.74	18.73	1.219	25.5%	25.5%
1 A 2 b	Non-ferrous Metals	50.34	2.22	1.136	23.8%	49.3%
2 C 1	Iron and Steel Production	37.21	3.02	0.663	13.9%	63.2%
6 C	WASTE INCINERATION	18.19	0.16	0.492	10.3%	73.5%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	0.75	3.42	0.416	8.7%	82.2%
	National Total	**160.76**	**35.45**			

Table 16: Key Categories for HCB gases for the year 2011.

Level Assessment

NFR Code	NFR Category	Latest Year (2011) Estimate [kg] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
1 A 4 b 1	Residential: stationary	26.27	70.2%	70.2%
1 A 4 c 1	Agriculture/Forestry/Fishing: Stationary	3.94	10.5%	80.7%
	National Total	**37.4**		

Trend Assessment

NFR Code	NFR Category	'Base Year' (1990) Estimate [kg] $E_{x,0}$	Latest Year (2011) Estimate [kg] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
1 A 4 b 1	Residential: stationary	17.15	1.00	0.393	35.0%	35.0%
1 A 2 b	Non-ferrous Metals	50.29	26.27	0.380	34.0%	69.0%
1 A 4 c 1	Agriculture/Forestry/Fishing: Stationary	2.55	3.94	0.190	17.0%	86.0%
	National Total	**92.00**	**37.4**			

Table 17: Key Categories for TSP gases for the year 2011.

Level Assessment

NFR Code	NFR Category	Latest Year (2011) Estimate [Mg] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
4 D 2	Soil operations	10875.77	18.2%	18.2%
1 A 3 b 7	R.T., Automobile road abrasion	10485.11	17.5%	35.7%
2 A 7 a	Quarrying and mining of minerals other than coal	10283.12	17.2%	52.9%
1 A 4 b 1	Residential: stationary	6870.87	11.5%	64.4%
2 A 7 b	Construction and demolition	2862.58	4.8%	69.1%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	2156.73	3.6%	72.7%
1 A 2 f 2	Mobile Combustion in Manufacturing Industries and Construction: Other	2110.31	3.5%	76.3%
1 A 3 c	Railways	1646.20	2.8%	79.0%
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	1523.90	2.5%	81.6%
	National Total	**59 849.82**		

Trend Assessment

NFR Code	NFR Category	'Base Year' (1990) Estimate [Mg] $E_{x,0}$	Latest Year (2011) Estimate [Mg] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
2 C 1	Iron and Steel Production	6 434.81	951.28	0.091	20.8%	20.8%
1 A 3 b 7	R.T., Automobile road abrasion	6 845.51	10485.11	0.069	15.7%	36.5%
1 A 4 b 1	Residential: stationary	10 273.77	6870.87	0.052	11.8%	48.3%
2 A 7 a	Quarrying and mining of minerals other than coal	8 215.54	10283.12	0.042	9.7%	58.0%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	438.41	2156.73	0.030	6.9%	64.9%
1 A 2 f 2	Mobile Combustion in Manufacturing Industries and Construction: Other	871.76	2110.31	0.022	5.1%	70.0%
2 A 7 b	Construction and demolition	1 758.62	2862.58	0.021	4.7%	74.7%
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	2 468.12	1523.90	0.015	3.3%	78.0%
1 A 3 b 3	R.T., Heavy duty vehicles	1 923.16	1002.29	0.015	3.3%	81.4%
	National Total	**62 527.92**	**59 849.82**			

Table 18: Key Categories for PM10 gases for the year 2011.

Level Assessment

NFR Code	NFR Category	Latest Year (2011) Estimate [Mg] $E_{x,t}$	Level Assessment $L_{x,t}$	Cumulative Total of $L_{x,t}$
1 A 4 b 1	Residential: stationary	6 260.06	18.1%	18.1%
4 D 2	Soil operations	4 895.50	14.2%	32.3%
2 A 7 a	Quarrying and mining of minerals other than coal	4 819.23	14.0%	46.3%
1 A 3 b 7	R.T., Automobile road abrasion	3 495.04	10.1%	56.4%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	1 941.06	5.6%	62.0%
2 A 7 b	Construction and demolition	1 431.29	4.1%	66.1%
1 A 3 b 1	R.T., Passenger cars	1 283.01	3.7%	69.9%
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	1 259.95	3.6%	73.5%
1 A 1 a	Public Electricity and Heat Production	1 231.44	3.6%	77.1%
1 A 2 f 2	Mobile Combustion in Manufacturing Industries and Construction: Other	1 188.76	3.4%	80.5%
	National Total	**34 533.12**		

Trend Assessment

NFR Code	NFR Category	'Base Year' (1990) Estimate [Mg] $E_{x,0}$	Latest Year (2011) Estimate [Mg] $E_{x,t}$	Trend Assessment $L_{x,t}$	Contribution to the trend	Cumulative Total of $L_{x,t}$
2 C 1	Iron and Steel Production	4 560.81	671.06	0.110	19.9%	19.9%
1 A 4 b 1	Residential: stationary	9 322.67	6 260.06	0.061	11.1%	31.1%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries & Construction: Other	394.57	1 941.06	0.053	9.7%	40.7%
1 A 3 b 7	R.T., Automobile road abrasion	2 281.84	3 495.04	0.050	9.2%	49.9%
2 A 7 a	Quarrying and mining of minerals other than coal	3 848.90	4 819.23	0.049	8.9%	58.8%
1 A 3 b 1	R.T., Passenger cars	681.57	1 283.01	0.023	4.2%	63.0%
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	2 242.91	1 259.95	0.023	4.2%	67.2%
1 A 3 b 3	R.T., Heavy duty vehicles	1 923.16	1 002.29	0.022	4.0%	71.2%

Trend Assessment						
NFR Code	**NFR Category**	**'Base Year' (1990) Estimate [Mg] $E_{x,0}$**	**Latest Year (2011) Estimate [Mg] $E_{x,t}$**	**Trend Assess-ment $L_{x,t}$**	**Contribution to the trend**	**Cumulative Total of $L_{x,t}$**
2 A 7 b	Construction and demolition	879.31	1 431.29	0.022	4.0%	75.3%
1 A 2 f 2	Mobile Combustion in Manufacturing Industries & Construction: Other	680.97	1 188.76	0.020	3.6%	78.9%
1 A 2 d	Pulp, Paper and Print	950.40	247.18	0.019	3.5%	82.4%
	National Total	**39 751.26**	**34 533.12**			

Table 19: Key Categories for PM2.5 gases for the year 2011.

Level Assessment				
NFR Code	**NFR Category**	**Latest Year (2011) Estimate [Mg] $E_{x,t}$**	**Level Assessment $L_{x,t}$**	**Cumulative Total of $L_{x,t}$**
1 A 4 b 1	Residential: stationary	5649.26	29.9%	29.9%
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	1617.55	8.6%	38.5%
1 A 3 b 1	R.T., Passenger cars	1283.01	6.8%	45.3%
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	1101.58	5.8%	51.1%
4 D 2	Soil operations	1090.55	5.8%	56.9%
1 A 3 b 7	R.T., Automobile road abrasion	1048.51	5.5%	62.4%
1 A 1 a	Public Electricity and Heat Production	1028.44	5.4%	67.8%
1 A 3 b 3	R.T., Heavy duty vehicles	1002.29	5.3%	73.2%
1 A 2 f 2	Mobile Combustion in Manufacturing Industries and Construction: Other	635.84	3.4%	76.5%
2 A 7 a	Quarrying and mining of minerals other than coal	544.11	2.9%	79.4%
3 D	OTHER including products containing HMs and POPs	446.31	2.4%	81.8%
	National Total	**18 893.36**		

Trend Assessment						
NFR Code	**NFR Category**	**'Base Year' (1990) Estimate [Mg] $E_{x,0}$**	**Latest Year (2011) Estimate [Mg] $E_{x,t}$**	**Trend Assessment $L_{x,t}$**	**Contribution to the trend**	**Cumulative Total of $L_{x,t}$**
1 A 2 f 1	Stationary Combustion in Manufacturing Industries and Construction: Other	328.80	1617.55	0.092	15.2%	15.2%
2 C 1	Iron and Steel Production	2 065.90	297.78	0.089	14.7%	29.8%
1 A 4 b 1	Residential: stationary	8 371.58	5649.26	0.061	10.1%	39.9%
1 A 3 b 1	R.T., Passenger cars	681.57	1283.01	0.051	8.3%	48.3%
1 A 4 c 2	Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery	2 107.79	1101.58	0.037	6.1%	54.4%
1 A 1 a	Public Electricity and Heat Production	639.77	1028.44	0.036	5.9%	60.3%
1 A 3 b 7	R.T., Automobile road abrasion	684.55	1048.51	0.035	5.7%	66.0%
1 A 3 b 3	R.T., Heavy duty vehicles	1 923.16	1002.29	0.034	5.6%	71.6%
1 A 2 d	Pulp, Paper and Print	781.44	203.24	0.028	4.6%	76.1%
1 A 4 a 1	Commercial/Institutional: Stationary	675.66	310.09	0.015	2.4%	78.6%
1 A 3 c	Railways	574.57	246.25	0.014	2.3%	80.8%
	National Total	**24 135.15**	**18 893.36**			

1.5 Quality Assurance and Quality Control (QA/QC)

A quality management system (QMS) has been designed to contribute to the objectives of *good practice guidance (GPG)*, namely to improve transparency, consistency, comparability, completeness and confidence (TACCC) in national inventories of emissions estimates.

The QMS was primarily developed to meet the requirement of reporting greenhouse gas emissions under the Kyoto Protocol. For this reason the emphasis was placed on greenhouse gases. All air pollutants are covered by the QMS; however, in the first instance the inspection body applied to accreditation for greenhouse gases only. In 2011, the quality manual has been completely revised, the new manual being more user-friendly and providing an improved presentation of requirements relating to reporting obligations in the context of emission inventories. In the course of this work the revision of ISO/IEC 17020 was taken into account,

The (former)[81] *Department of Air Emissions* of the Umweltbundesamt has decided to implement a QMS based on the International Standard ISO/IEC 17020 *General Criteria for the operation of various types of bodies performing inspections*[82]. Consequently the QMS contains all relevant features of international standard such as strict independence, impartiality and integrity of accredited bodies. Furthermore the QMS ensures the fulfilment of requirements as stipulated in Chapter 8 of the IPCC-GPG[83] and Chapter 6 of the EMEP/EEA emission inventory guidebook 2009[84].

The QMS was fully implemented by the end of 2003, and the accreditation audit of the *Department for Air Emissions* as inspection body took place in autumn 2005, it was renewed in the beginning of 2011: the Umweltbundesamt is an ISO/IEC 17020 accredited inspection body for Emission Inventories (Id. No. 241) in accordance with the Austrian Accreditation Law (AkkG)[85] .

The revised manual also considers the requirements under NEC, and in fact for many sources – where the methodology is the same for GHG and main air pollutants – the QMS covers the main air pollutants already. Subject to available resources it is planned to also integrate the remaining categories (that are relevant for main pollutants only) into the QMS in 2013/2014.

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[81] Now: Air pollutant control & climate change mitigation

[82] The International Standard ISO 17020 has replaced the European Standard EN 45004.

[83] Good Practice Guidance by the Intergovernmental Panel on Climate Change

[84] http://www.eea.europa.eu/publications/emep-eea-emission-inventory-guidebook-2009

[85] Federal Law Gazette No. 468/1992 last amended by federal law gazette I No. 85/2002, by decree of the Minister of Economics and Labour, No. BMWA- 92.715/0036-I/12/2005, issued on 19 January, valid from 23 December 2005. http://www.bmwa.gv.at/NR/rdonlyres/4E4C573C-4628-4B05-9DB6-D0A7C6E7EF81/216/Akkreditierungsgesetz_Englisch1.pdf

The Austrian Quality Management System (QMS) and requirements of IPCC GPG and Good Practice for LRTAP Emission Inventories

The implementation of QA/QC procedures as required by the IPCC-GPG and the Good Practice for LRTAP Emission Inventories support the development of national greenhouse gas inventories that can be readily assessed in terms of quality and completeness. The QMS as implemented in the Austrian inventory includes all elements of the QA/QC system outlined in the IPCC-GPG Chapter 8 „Quality Assurance and Quality Control" and the EMEP/EEA emission inventory guidebook 2009 Chapter 6 "Inventory management, improvement and QA/QC" (see next sub-chapter), and goes beyond. It also comprises supporting and management processes in addition to the QA/QC procedures in inventory compilation and thus ensures agreed standards not only within (i) the inventory compilation process and (ii) supporting processes (e.g. archiving), but also for (iii) management processes (e.g. annual management reviews, internal audits, regular training of personnel, definition of procedures for external communication).

Design of the Austrian QMS

The design of the QMS of the *Inspection Body for Emission Inventories* at the Umweltbundesamt follows a *process based approach*. **As already outlined above, in the first instance the inspection body applied to accreditation for greenhouse gases only. However, all air pollutants are covered by the QMS.** The QMS is illustrated in Figure 5.

The Quality Manual of the Inspection Body for Emission Inventories is published on: http://www.umweltbundesamt.at/umweltsituation/luft/emissionsinventur/emi_ueberwachung/

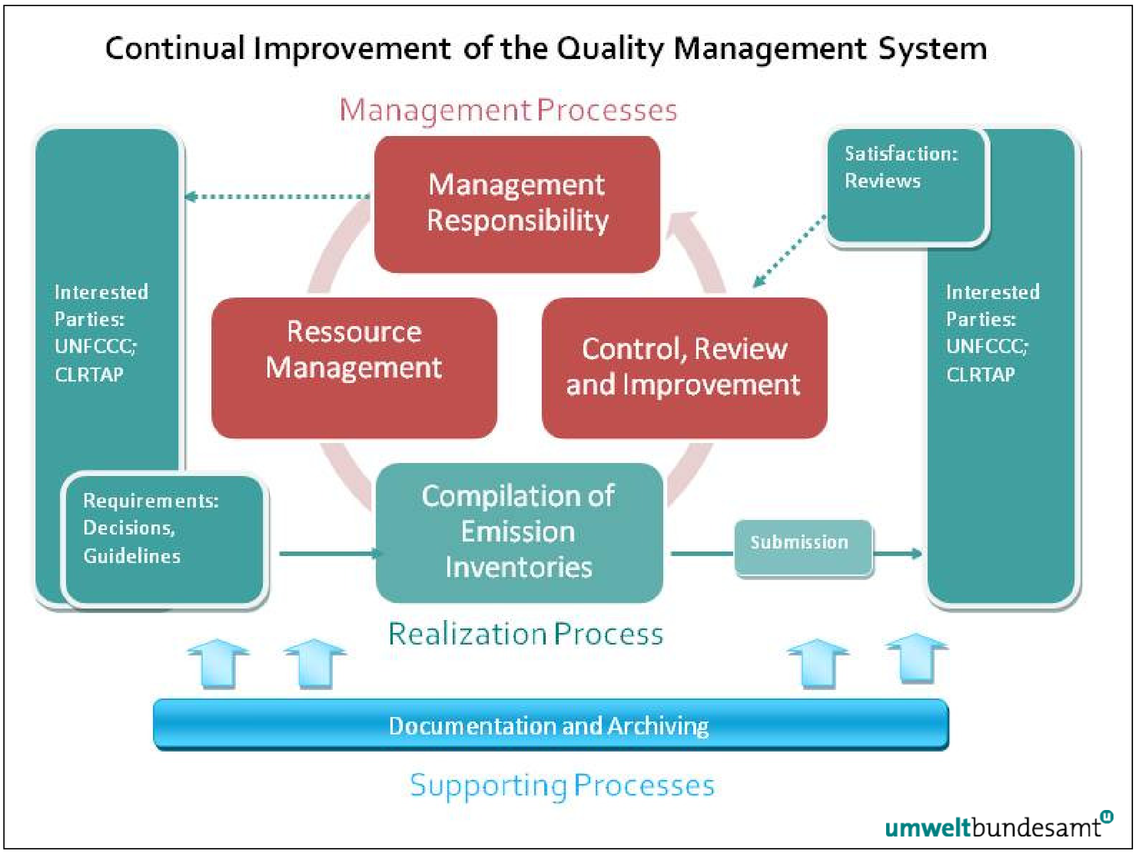


Figure 5: Process-based QMS.

Procedures of QA/QC

QA/QC Plan

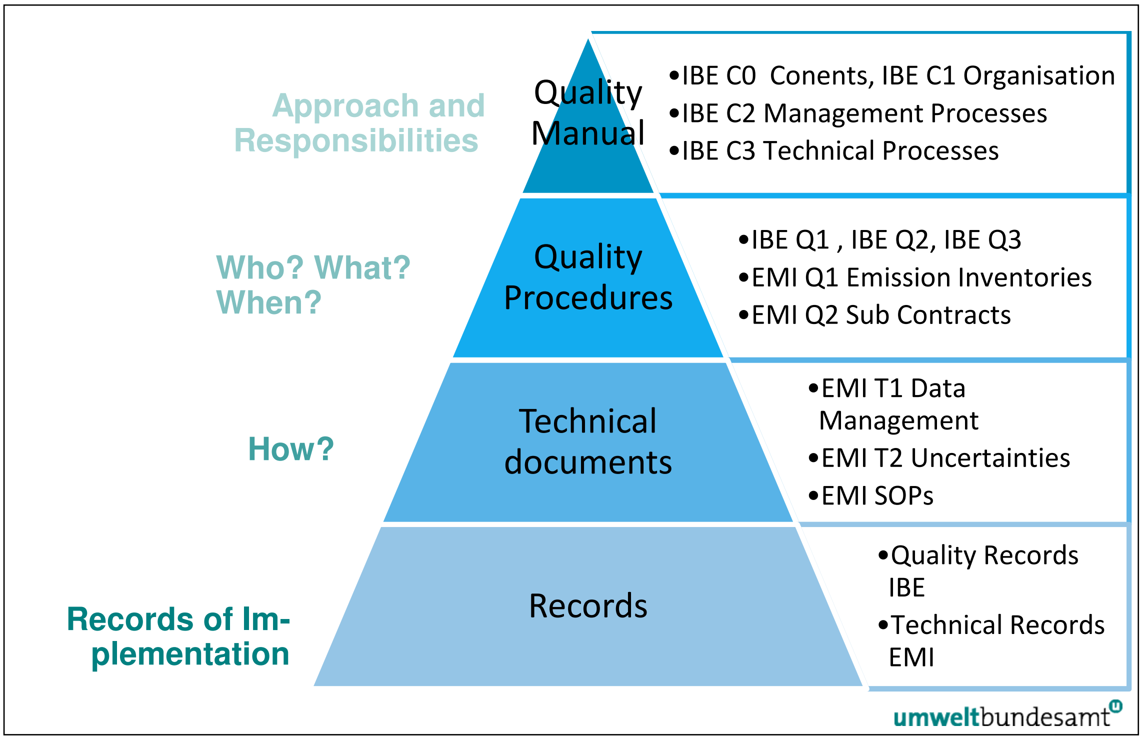
Activities to be conducted by the personnel of the inspection body are written down in quality and technical procedures, respectivley that complement the Quality Manual. Such activities are:

- QC activities
- procedures for country specific methodologies
- internal audits (QM specific)
- procedures for sub-contracting
- inventory improvement plan
- documentation and archiving
- treatment of confidential data
- annual management review

Quality Manual

The Quality Manual is divided into three levels, where the activities as listed above form Level 2:

- Level 1: General (the actual "quality manual": general information, description of QMS, general responsibilities etc.)
- Level 2+3: Detailed description of activities to be conducted and checklists and forms to be filled out.
- Level 4: Documentation of QC activities (filled out checklists, ...)



QC Activities

QC activities are mainly performed by the sector experts themselves (first party) after inventory work has been finished. However, where possible the deputy of the sector experts conducts QC checks (second party). Additionally electronic checks (e.g. check for completeness and comparison with last year's inventory) are performed by the project manager, who is also responsible for data management of the inventory: Tier 2/category specific: by SE in the course of the inventory preparation

Tier 1/general QC Activities:

- Step 1: QC by the SE after emissions have been estimated
- Step 2: QC by the DM in the course of the preparation of the overall inventory
- Step 3: QC by the SE or deputy after inventory is finished

QC activities are conducted following QC checklists, which cover Tier 1 QC (general QC) such as formal aspects (check of IPCC quality objectives TACCC) as well as Tier 2 QC (source specific QC).

The checklists cover questions like:

- ✓ Are all references clearly made?
- ✓ Are all assumptions documented?
- ✓ Are the correct values used (check for transcription errors etc.)?
- ✓ check of calculations, units etc.
- ✓ Is the data set complete for the whole time series?
- ✓ check of plausibility of results (time-series, order of magnitude etc.)
- ✓ correct transformation/transcription into NFR
- ✓ Are all recalculations clearly explained?
- ✓ Is the data applicable?
- ✓ Where possible data is checked with data from other sources, order of magnitude checks etc.

The checklists cover all aspects as required according to Table 8.1 of the IPCC GPG (2000) and Chapter 6 of the EMEP/EEA emission inventory guidebook 2009.

QC activities proved to be helpful to identify errors as well as lack in transparency before inventory data is published.

QA Activities

The following QA activities are performed:

Annual second party audits for every sector: check of emission estimation and reporting process (from archiving of underlying information, emission calculation, input into the data management system, documentation, information in the IIR etc.) for transparency, reproducibility, clearness and completeness. This tool proved to be very helpful in order to further improve the documentation and the implementation of (new) QA/QC routines.

Second party audits for work performed by sub-contractors:

The sector expert at the Umweltbundesamt is responsible for incorporation of results in inventory database and additional QA/QC (works as second party audit).

Audits of data suppliers

In 2007, the Audit[86] of the main data supplier Statistik Austria (energy balance) in 2007 took place. In 2009, the main data supplier for estimates of the waste sector (landfill data base), and agricultural statistical data from Statistik Austria was audited. Furthermore the Institut of Industrial Ecology (IIÖ), which developed (2002) and updated (2008) the solvent model, have been audited. It is planned to audit all data suppliers for GHG data, which are not certified or deliver verified data until 2015.

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[86] www.statistik.at/web_de/static/subdokumente/r_energiebilanzen_auditbericht_stat.pdf

Error correction and continuous improvement

All issues regarding transparency, accuracy, completeness, consistency or comparability identified by experts from different backgrounds are incorporated in the inventory improvement plan. Sources of these findings are:

- UNFCCC and UNECE/LRTAP Review: The last in-depth review (stage 3) took place in 2010; findings were commented in the IIR 2011 (UMWELTBUNDESAMT 2011f). The last in-depth review (stage 1 and 2) took place in 2012.
- external experts (e.g. experts from federal provinces: some of them who prepare a partly independent emission inventory for their federal province compare their results with the disaggregated national inventory),
- stakeholders (e.g. industrial facilities or association of industries: the NIR is communicated to every data supplier and Austrian experts involved in emission inventorying after submission),
- personnel of the inspection body (head of inspection body, project leader sector experts etc.).

Archiving and documentation

Within the inventory system, a system for transparent documentation of inventory data and information (assumptions etc.) that allows the reproduction of the inventory is implemented. To allow clear references in documentation of the inventory, an archiving system for literature, mails, documents (e.g. review reports), calculations, with an access database containing the archived information is used. The archived documents are stored on a server and/or in the inventory archive (paper).

For each sector the documentation includes:

Documentation of the methodology:

- description (source, emissions, key source, completeness, uncertainty),
- methodology,
- template for emission estimation ,
- documentation of validation.

Documentation of actual emission calculation:

- "logbook" (who did what and when),
- Calculation file,
- references for activity data, emission factor and/or emissions, respectively,
- documentation of assumptions, sources of data and information, expert judgements etc. to allow full reproduction,
- recalculations,
- planned improvement,
- QC activitities.

Focus of QA/QC activities in the year 2012/2013

In sector agriculture losses of gaseous N species are calculated following the mass-flow procedure pursuant to EMEP/EEA. A detailed description of the applied methods is given in this report. Minor inconsistencies of the AWMS distribution data within the ammonia and the greenhouse gas inventory have been found and corrected.

1.6 Uncertainty Assessment

So far, no quantitative uncertainty assessment for any of the pollutants or pollutant groups relevant for this report has been made. For GHGs a comprehensive uncertainty assessment has already been performed.

However, the quality of estimates for all relevant pollutants has been rated using qualitative indicators as suggested in Chapter 5 of the EMEP/EEA emission inventory guidebook 2009. The definition of the ratings is given in Table 20, the ratings for the emission estimates are presented in Table 22.

Table 20: Definitions of qualitative rating.

Rating	Definition	Typical Error Range
A	An estimate based on a large number of measurements made at a large number of facilities that fully represent the sector	10 to 30%
B	An estimate based on a large number of measurements made at a large number of facilities that represent a large part of the sector	20 to 60%
C	An estimate based on a number of measurements made at a small number of representative facilities, or an engineering judgement based on a number of relevant facts	50 to 200%
D	An estimate based on single measurements, or an engineering calculation derived from a number of relevant	100 to 300%
E	An estimate based on an engineering calculation derived from assumptions only	order of magnitude

Source: Table 3-2 Rating definitions, Chapter 5 of the EMEP/EEA emission inventory guidebook 2009.

Furthermore, for HM and POPs qualitative „quality indicators" have been assigned to each emission value, and based on these values, a „semi-quantitative" value for the overall uncertainty of the HM and POPs emission inventory was calculated. As uncertainties for HM and POP emissions are generally relatively high (related to uncertainties to e.g. main pollutants or CO_2) and often difficult to determine, this „semi-quantitative" approach is considered to be a good approximation.

First, the main influences on the uncertainty of emission data were identified and the criteria were graded for every emission source:

- Influence on the uncertainty mainly related to the emission factor
  - (i) data availability (1 = representative sample, 2–4 = fair/medium/poor data availability, 5 = no measured data/indirect estimation);
  - (ii) the variation of the emission values (difference of measured or reported values: 10^1 = 1, …, 10^5 or more = 5).
- Influence on the uncertainty mainly related to the activity data
  - (iii) the homogeneity of emitters (1 = similar, …, 3 = different);
  - (iv) quality of activity data (1 = good, …, 3 = poor).

An arithmetic mean of the different grades was calculated; as the first two criteria have a higher impact on the uncertainty of the emission value, there were five grades were to choose from compared to three grades for the other two criteria. Thus the arithmetic mean is more dependent on the more important criteria. This resulted in a single quality indicator for each emission value.

To estimate the overall inventory uncertainty the quality indicators of the different emission sources were weighted according to the share in total emissions and the mean was calculated; This resulted in a single quality indicator for the overall inventory (for total emissions of one pollutant).

Statistically it can be deduced that an increase of the quality indicator by a value of 1 corresponds to a decrease in the quality and thus a increase in the variation by a factor of 2.

Finally, to calculate the variation of total emissions ("uncertainty") from of the weighted quality indicator the following assumption was made: as emission values are usually asymmetrically distributed, the „true" value (the value used for the inventory) reflects the geometrical mean value of the distribution. Using this assumption the variation of total emissions can be calculated using the following formula:

$$\frac{x}{\sqrt{2\exp(QI)}} \leq x \leq x \bullet \sqrt{2\exp(QI)}$$

QI…weighed quality indicator

x…"true" emission value (value used in the inventory)

The following table presents the results for HM and POPs. For POP emissions a factor of about 3 was determined, and a factor of about 2 for HM emissions.

Table 21: Variation of total emissions ("uncertainty") of HM and POP emissions.

Uncertainty[87]	**1999**		**2000**		
	Emission [kg]	**Variation**		**Emission [t]**	**Variation**
PCDD/F/Furan	0.18	0.08–0.4	Cd	0.97	0.5–2.1
HCB	47	20–130	Hg	0.88	0.5–1.7
PAHs	28 000	10 000–80 000	Pb	12.4	6.0–26

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[87] The analysis was performed in 2001 for emission data of 1999 for POPs and 2000 for HM. As emissions have been recalculated since then the presented emission values differ slightly from values reported now.

Table 22: Quality of emission estimates.

NFR	Description	SO_2	NO_x	NMVOC	NH_3	CO	Cd	Hg	Pb	PAH	Diox	HCB	TSP	PM10	PM2.5
1 A 1 a	**Public Electricity and Heat Production**	**A**	**A**	D	E	A	**C**	**C**	**C**	C	**C**	C	**B**	**C**	**C**
1 A 1 b	**Petroleum refining**	**A**	**A**		E	A	**C**	C	**C**	D	D	D	A	B	B
1 A 1 c	Manufacture of Solid fuels & Other Energy Ind.		B	D	E	D					D	D	B	B	B
1 A 2 mobile	**Other mobile in industry**	A	**B**	**B**	C	**B**	C	C	C	D	D	D	**B**	**B**	**B**
1 A 2 stat (l)	**Manuf. Ind. and Constr. stationary LIQUID**	**A**	**B**	D	E	C	**C**	**B**	**C**	C	E	D	C	C	**C**
1 A 3 a	Civil Aviation	A	B	B	C	B	B	B	B				B	B	B
1 A 3 b 1	**R.T., Passenger cars**	A	**B**	**B**	**C**	**B**	B	B	C	**C**	**D**	D	**B**	**B**	**B**
1 A 3 b 2	**R.T., Light duty vehicles**	A	**B**	B	C	B	B	B	C	**C**	D	D	B	**B**	**B**
1 A 3 b 3	**R.T., Heavy duty vehicles**	**A**	**B**	**B**	C	**B**	B	B	C	**C**	**D**	D	**B**	**B**	**B**
1 A 3 b 4	**R.T., Mopeds & Motorcycles**		B	B	C	**B**	B	B	C	D	D	D			
1 A 3 b 5	**R.T., Gasoline evaporation**			**B**											
1 A 3 b 6	**R.T., Automobile tyre and break wear**						**C**	C	C				**C**	**C**	**C**
1 A 3 c	**Railways**	A	B	B	C	B	B	B	C	D	D	D	**B**	**B**	B
1 A 3 d	Navigation	A	B	B	C	B	B	B	C	D	D	D	B	B	B
1 A 3 e	Other		A	D	E	C						D	C	C	C
1 A 4 mob	**Other Sectors – mobile**	A	**B**	**B**	C	**B**	C	C	C	**D**	D	D	**B**	**B**	**B**
1 A 4 stat (b)	**Other Sectors stationary BIOMASS**	**A**	**B**	**C**	E	**C**	**C**	**C**	**D**	**D**	**E**	**D**	**C**	**C**	**C**
1 A 5	Other	B	C	C	D	C	C	C	C	D	D	D	C	C	C

NFR	Description	SO_2	NO_x	NMVOC	NH_3	CO	Cd	Hg	Pb	PAH	Diox	HCB	TSP	PM10	PM2.5
1 B	**FUGITIVE EMISSIONS FROM FUELS**	A		**A**									D	D	D
2 A	**MINERAL PRODUCTS**					**C**							**D**	**D**	**D**
2 B	**CHEMICAL INDUSTRY**	**B**	B	**D**	A	**D**	A	A	B				A	A	A
2 C	**METAL PRODUCTION**	**C**	B	C		B	**B**	**B**	**C**	**C**	**C**	**C**	**B**	**B**	**B**
2 D	**OTHER PRODUCTION**		B	**B**		B				E	E	E	D	D	D
2 G	OTHER				E										
3	**SOLVENT AND OTHER PRODUCT USE**			**A**			B		B						
4 B 1	**Cattle**				**B**										
4 B 3	**Sheep**				**B**										
4 B 4	Goats				B										
4 B 6	Horses				B										
4 B 8	**Swine**				**B**										
4 B 9	**Poultry**				**B**										
4 B-13	Other				B										
4 D	**AGRICULTURAL SOILS**		**B**	E	**B**								**D**	**D**	**D**
4 F	**FIELD BURNING OF AGRIC. RESIDUES**	E	E	E	E	E	E	E	E	**E**	E	E			
4 G	**Agriculture – Other**												**D**	**D**	**D**
6	**WASTE**	D	D	C	C	**C**	B	B	B	D	D	B	D	D	D

Abbreviations: see Table 20;

(dark shaded cells indicate that no such emissions arise from this source, light shaded cells (green) indicate that source is a key source for this pollutant)

1.7 Completeness

The emission data presented in this report were compiled according to the Guidelines for Reporting Emission Data (ECE/EB.AIR/97) approved by the Executive Body for the UNECE/LRTAP Convention at its 26th session.

The inventory is complete with regard to reported gases, reported years and reported emissions from all sources, and also complete in terms of geographic coverage.

Geographic Coverage

The geographic coverage is complete. There is no territory in Austria not covered by the inventory.

However, if fuel prices vary considerably in neighbouring countries, fuel sold within the territory of a Party is used outside its territory (so-called 'fuel export'). Austria has experienced a considerable amount of 'fuel export' in the last few years.

According to the 2009 Revised Guidelines for Reporting Emission Data, Parties within the EMEP region should calculate and report emissions, consistent with national energy balances reported to Eurostat or the International Energy Agency (IEA). Emissions from road vehicle transport should therefore be calculated and reported on the basis of the fuel sold. In addition, Parties may report emissions from road vehicles based on fuel used in the geographic area of the Party.

In the report to the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP) emissions of the Austrian road transport sector are reported on the basis of fuel sold whereas in the report[88] under the National Emissions Ceiling Directive (NECD) they are accounted on the basis of 'fuel used'. The Austrian NEC Totals therefore differ from the LRTAP Totals presented in this report (see Annex, chapter 12.3).

Gases, Reporting Years

In accordance with the Austrian obligation, all relevant pollutants mentioned in Table 2 (minimum reporting programme) are covered by the Austrian inventory and are reported for the years 1980–2011 for the main pollutants, from 1985 onwards for POPs and HMs and for the years 1990, 1995 and from 2000 onwards for PM.

Sources

Notation keys are used according to the Guidelines for Estimating and Reporting Emission Data under CLRTAP (ECE/EB.AIR/97) (see Table 23) to indicate where emissions are not occurring in Austria, where emissions have not been estimated or have been included elsewhere as suggested by EMEP/EEA emission inventory guidebook 2009. The main reason for different allocations to categories are the allocation in national statistics, insufficient information on the national statistics, national methods, and the impossibility to disaggregate emission declarations; explanations for each the case is given in the NFR-Table Additional info.

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[88] For more information, see UMWELTBUNDESAMT (2011): Austria's National Air Emission Inventory 1990–2010: Submission under Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants. Vienna. http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0358.pdf

Table 23: Notation keys used in the NFR.

Abbreviation	Meaning	Objective
NO	not occurring	for emissions by sources of compounds that do not occur for a particular compound or source category within a country;
NA	not applicable	is used for activities in a given source category which are believed not to result in significant emissions of a specific compound;
NE	not estimated	for existing emissions by sources of compounds that have not been estimated; Where "NE" is used in an inventory the Party should indicate why emissions could not be estimated.
IE	included elsewhere	for emissions by sources of compounds that are estimated but included elsewhere in the inventory instead of in the expected source category; Where "IE" is used in an inventory, the Party should indicate where in the inventory the emissions from the displaced source category have been included and the Party should give the reasons for this inclusion deviating from the expected category.
C	confidential	for emissions by sources of compounds which could lead to the disclosure of confidential information; Where "C" is used in an inventory, reference should be made to the Protocol provision that authorizes such practice.
NR	not relevant	According to Para. 9 in the Emission Guidelines, Emission inventory reporting should cover all years from 1980 onwards, if data are available. However, "NR" (Not Relevant) is introduced to ease the reporting where emissions are not strictly required by the different Protocols. E.g. for some Parties emissions of NMVOC prior to 1988.

2 TREND IN TOTAL EMISSIONS

The 1985 Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes

The Protocol to the Convention on LRTAP on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent entered into force in 1987.[89] Twenty-one UNECE countries are Parties to this Protocol, which aims at abating one of the major air pollutants. As a result of this Protocol, substantial cuts in sulphur emissions have been recorded in Europe: Taken as a whole, the 21 Parties to the 1985 Sulphur Protocol reduced 1980 sulphur emissions by more than 50% by 1993 (using the latest available figure, where no data were available for 1993). Also individually, based on the latest available data, all Parties to the Protocol have reached the reduction target. Eleven Parties have achieved reductions of at least 60%. Given the target year 1993 for the 1985 Sulphur Protocol, it can be concluded that all Parties to that Protocol have reached the target of reducing emissions by at least 30%.

In Austria, SO_2 emissions in the base year 1980 amouned to 334 Gg, by the year 1993 emissions were reduced to 54 Gg corresponding to a reduction of 84%. In 2011, SO_2 emissions in Austria amounted to 19 Gg, which is a decrease by 95% compared to 1980. This reduction could be achieved mainly due to lower emissions from residential heating, combustion in industries and energy industries.

The 1988 Sofia Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes

In 1988 the Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes was adopted in Sofia (Bulgaria).[90] This Protocol requires as a first step, to freeze emissions of nitrogen oxides or their transboundary fluxes. The general reference year is 1987[91].

Taking the sum of emissions of Parties to the NO_x Protocol in 1994, or a previous year, where no recent data are available, also a reduction of 9% compared to 1987 can be noted. Nineteen of the 25 Parties to the 1988 NO_x Protocol have reached the target and stabilized emissions at 1987[92] levels or reduced emissions below that level according to the latest emission data reported.

The second step to the NO_x Protocol requires the application of an effects-based approach. Applying the multi-pollutant, multi-effect critical load approach, a new instrument being prepared at present should provide for further reduction of emissions of nitrogen compounds, including ammonia, and volatile organic compounds, in view of their contribution to photochemical pollution, acidification and eutrophication, and their effects on human health, the environment and materials, by addressing all significant emission sources.

The collection of scientific and technical information as a basis for a further reduction in nitrogen oxides and ammonia, considering their acidifying as well as nitrifying effects, is under way.

Austria was successful in fulfilling the stabilisation target set out in the Protocol: NO_x emissions decreased steadily from the base year 1987 until the mid-1990s. However, since then emissions have been increasing again and the NO_x emissions had reached an all-time high in 2005 with 238 Gg. In 2005 emissions significantly exceeded 1987 levels. The main reasons are strongly increasing emissions from heavy duty vehicles, which is mainly caused by 'fuel export'.

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[89] http://www.unece.org/env/lrtap/sulf_h1.htm

[90] http://www.unece.org/env/lrtap/nitr_h1.htm

[91] with the exception of the United States that chose to relate its emission target to 1978

[92] or in the case of the United States 1978

Austrian NO_x emissions in the base year under this Protocol amounted to 209 Gg; by the year 1995 emissions were reduced to 182 Gg corresponding to a reduction of 13%. In 2011, NO_x emissions in Austria amounted to 183 Gg, which is a decrease by 12% compared to 1987.[93]

The 1991 Geneva Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes

In November 1991, the Protocol to the Convention on Long-range Transboundary Air Pollution on the Control of Emissions of Volatile Organic Compounds (VOCs, i.e. hydrocarbons) or their Transboundary Fluxes, the second major air pollutant responsible for the formation of ground level ozone, was adopted. It has entered into force on 29 September 1997.[94]

This Protocol specifies three options for emission reduction targets that have to be chosen upon signature or upon ratification:

(i) 30% reduction in emissions of volatile organic compounds (VOCs) by 1999 using a year between 1984 and 1990 as a basis;[95]

(ii) The same reduction as for (i) within a Tropospheric Ozone Management Area (TOMA) specified in annex I to the Protocol and ensuring that by 1999 total national emissions do not exceed 1988 levels;[96]

(iii) Finally, where emissions in 1988 did not exceed certain specified levels, Parties may opt for a stabilization at that level of emission by 1999.[97]

Austria met the reduction target: in the base year NMVOC emissions amounted to 346 Gg, in 1999 emissions were reduced by 51% to 171 Gg. From 1999 to 2011 a further reduction by 25% took place (128 Gg in 2011), whereas from 2000 to 2003 a stagnation and from 2004 to 2006 a temporary increase could be noted. After an emission increase between 2009 and 2010 due to the economic recovery, emissions could be reduced by about 5% between 2010 and 2011.

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[93] Please note that emissions from mobile sources are calculated based on fuel sold (which is consistent with submission under the UNFCCC and the Kyoto Protocol), which for the last few years is considerably higher than fuel used: emissions for 2011 based on fuel used amount to 144 Gg (see Chapter 1.7 Completeness for more information regarding 'fuel export').

Austria's emissions based on fuel used – thus excluding 'fuel export' – are presented in Chapter 12.3 'Austria's emissions for SO2, NOx, NMVOC and NH3 according to the submission under NEC directive' (Annex Table A-15 and Table A-17). In the related report 'AUSTRIA'S ANNUAL AIR EMISSION INVENTORY 1990–2011. Submission under National Emission Ceilings Directive 2001/81/EC' is published on the following website:

http://www.umweltbundesamt.at/aktuell/publikationen/publikationssuche/publikationsdetail/?pub_id=1995

[94] http://www.unece.org/env/lrtap/vola_h1.htm

[95] This option has been chosen by Austria, Belgium, Estonia, Finland, France, Germany, Netherlands, Portugal, Spain, Sweden and the United Kingdom with 1988 as base year, by Denmark with 1985, by Liechtenstein, Switzerland and the United States with 1984, and by Czech Republic, Italy, Luxembourg, Monaco and Slovakia with 1990 as base year.

[96] Annex I specifies TOMAs in Norway (base year 1989) and Canada (base year 1988).

[97] This has been chosen by Bulgaria, Greece, and Hungary.

The 1998 Aarhus Protocol on Heavy Metals

The Executive Body adopted the Protocol on Heavy Metals on 24 June 1998 in Aarhus (Denmark).[98] It targets three particularly harmful metals: cadmium, lead and mercury. According to one of the basic obligations, Parties will have to reduce their emissions for these three metals below their levels in 1990 (or an alternative year between 1985 and 1995). The Protocol entered into force on 29th December 2003.

The Protocol aims to cut emissions from industrial sources (iron and steel industry, non-ferrous metal industry), combustion processes (power generation, road transport) and waste incineration. It lays down stringent limit values for emissions from stationary sources and suggests best available techniques (BAT) for these sources, such as special filters or scrubbers for combustion sources or mercury-free processes. The Protocol requires Parties to phase out leaded petrol. It also introduces measures to lower heavy metal emissions from other products, such as mercury in batteries, and proposes the introduction of management measures for other mercury-containing products, such as electrical components (thermostats, switches), measuring devices (thermometers, manometers, barometers), fluorescent lamps, dental amalgam, pesticides and paint.

The Protocol was amended in 2012, to adopt more stringent controls of heavy metals emissions and introduce flexibilities to facilitate accession of new Parties, notably countries in Eastern Europe, the Caucasus and Central Asia.

Austria has chosen 1985 as a base year and current emissions are well below the level of the base year (see Chapter 2.3).

The 1998 Aarhus Protocol on Persistent Organic Pollutants (POPs)

The Executive Body adopted the Protocol on Persistent Organic Pollutants on 24 June 1998 in Aarhus (Denmark)[99]. It entered into force on 23 October 2003. It focuses on a list of 16 substances that have been singled out according to agreed risk criteria. The substances comprise eleven pesticides, two industrial chemicals and three by-products/contaminants. The ultimate objective is to eliminate any discharges, emissions and losses of POPs. The Protocol bans the production and use of some products outright (aldrin, chlordane, chlordecone, dieldrin, endrin, hexabromobiphenyl, mirex and toxaphene). Others are scheduled for elimination at a later stage (DDT, heptachlor, hexaclorobenzene, PCBs). Finally, the Protocol severely restricts the use of DDT, HCH (including lindane) and PCBs.

The Protocol includes provisions for dealing with the wastes of products that will be banned. It also obliges Parties to reduce their emissions of dioxins/furans (PCDD/F), PAHs and HCB below their levels in 1990 (or an alternative year between 1985 and 1995). For the incineration of municipal, hazardous and medical waste, it lays down specific limit values.

Austria has chosen 1985 as a base year and current emissions are well below the level of the base year (see Chapter 2.4).

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[98] http://www.unece.org/env/lrtap/hm_h1.htm

[99] http://www.unece.org/env/lrtap/pops_h1.htm

The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone "Multi-Effect Protocol"

The Executive Body adopted the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone in Gothenburg (Sweden) on 30 November 1999[100].

The Protocol sets emission ceilings for 2010 for four pollutants: sulphur, NO_x, VOCs and ammonia. These ceilings were negotiated on the basis of scientific assessments of pollution effects and abatement options. Parties whose emissions have a more severe environmental or health impact and whose emissions are relatively cheap to reduce will have to make the biggest cuts. Once the Protocol is fully implemented, Europe's sulphur emissions should be cut by at least 63%, its NO_x emissions by 41%, its VOC emissions by 40% and its ammonia emissions by 17% compared to 1990.

The Protocol also sets tight limit values for specific emission sources (e.g. combustion plant, electricity production, dry cleaning, cars and lorries) and requires best available techniques to be used to keep emissions down. VOC emissions from such products as paints or aerosols will also have to be cut. Finally, farmers will have to take specific measures to control ammonia emissions. Guidance documents adopted together with the Protocol provide a wide range of abatement techniques and economic instruments for the reduction of emissions in the relevant sectors, including transport.

It has been estimated that once the Protocol is implemented, the area in Europe with excessive levels of acidification will shrink from 93 million hectares in 1990 to 15 million hectares. That with excessive levels of eutrophication will fall from 165 million hectares in 1990 to 108 million hectares. The number of days with excessive ozone levels will be halved. Consequently, it is estimated that life-years lost as a result of the chronic effects of ozone exposure will be about 2 300 000 lower in 2010 than in 1990, and there will be approximately 47 500 fewer premature deaths resulting from ozone and particulate matter in the air. The exposure of vegetation to excessive ozone levels will be 44% down on 1990.

Austria has not ratified the Protocol and is not Party to the Protocol.

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[100] http://www.unece.org/env/lrtap/multi_h1.htm

2.1 Emission Trends for Air Pollutants covered by the Multi- Effect Protocol as well as CO

National total emissions and trends (1990–2011) for air pollutants covered by the Multi-Effect Protocol are shown in Table 24. Please note that emissions from mobile sources are calculated based on fuel sold in Austria, thus national total emissions include 'fuel export'.[101]

Table 24: National total emissions and trends 1990–2011 for air pollutants covered by the Multi-Effect Protocol and CO.

Year	**Emission [Gg]**				
	SO_2	**NO_x**	**NMVOC**	**NH_3**	**CO**
1990	74.45	195.47	276.47	65.39	1 436.4
1991	71.57	202.67	266.85	67.91	1 500.5
1992	55.18	193.05	241.87	66.92	1 471.5
1993	53.55	187.70	242.81	68.24	1 439.7
1994	47.94	181.95	226.74	69.99	1 386.5
1995	47.52	181.95	226.55	70.75	1 273.5
1996	44.78	203.99	220.62	68.68	1 248.3
1997	40.24	191.98	204.72	68.77	1 151.3
1998	35.60	205.92	188.22	69.19	1 109.7
1999	33.79	198.78	174.49	67.08	1 031.7
2000	31.72	206.35	178.73	64.66	958.4
2001	32.77	216.47	177.47	64.53	919.8
2002	31.26	222.86	176.69	63.75	884.2
2003	31.98	234.28	173.34	63.67	877.2
2004	27.44	233.15	154.36	62.93	839.5
2005	27.15	237.52	162.54	62.72	814.4
2006	27.82	223.15	172.67	62.61	773.8
2007	24.38	216.95	159.10	63.46	722.0
2008	22.00	204.49	150.07	62.69	683.9
2009	17.73	188.85	121.33	63.42	637.7
2010	18.85	193.16	133.01	63.19	644.7
2011	18.51	182.71	127.17	62.33	608.8
Trend 1990–2011	**-75.1%**	**-6.5%**	**-54.0%**	**-4.7%**	**-57.6%**

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[101] For NO_x the emissions calculated based on fuel used are by about 39 Gg lower in 2011 and show a 21% decrease from 1990 to 2011.

Austria's emissions based on fuel used – thus excluding 'fuel export' – are presented in Chapter 12.3 'Austria's emissions for SO2, NOx, NMVOC and NH3 according to the submission under NEC directive' (Annex Table A-15 and Table A-17). In the related report 'AUSTRIA'S ANNUAL AIR EMISSION INVENTORY 1990–2011. Submission under National Emission Ceilings Directive 2001/81/EC' is published on the following website:

http://www.umweltbundesamt.at/aktuell/publikationen/publikationssuche/publikationsdetail/?pub_id=1995

2.1.1 SO_2 Emissions

In 1990, national total SO_2 emissions amounted to 74 Gg; emissions have decreased quite steadily since then and by the year 2011 emissions were reduced by 75% mainly due to lower emissions from residential heating, combustion in industries and in energy industries. Since the significant reduction as a result of the crisis in 2009, emissions are increasing again in 2010 and 2011 reflecting the recovery of the economy.

As shown in Table 25 the main source for SO_2 emissions in Austria, with a share of 97% in 1990 and 93% in 2011, is Category *1 A Fuel Combustion Activities*. Within this source, the iron and steel industry as well as the residential heating are the highest contributors to total SO_2 emissions.

SO_2 Emission Trends in Category 1 A Fuel Combustion Activities

SO_2 emissions from NFR Category 1 A Fuel Combustion Activities were reduced over the period from 1990 to 2011: as can be seen in Table 25 in 1990 emissions amounted to 70 Gg. In 2011, they were 76% lower (17 Gg). The share of SO_2 emissions from this category in national total emissions was about 94% in 1990 and 92% in 2011. In 2011, within this source, the main sources for SO_2 emissions are:

	Contribution in Total SO_2 emission (2011)
● NFR 1 A 1 Energy Industries	16%
● NFR 1 A 2 Manufacturing Industries and Construction	61%
● NFR 1 A 3 Transport	2%
● NFR 1 A 4 Other Sectors (Comercial, Institutional and Residential heating etc.)	13%
● NFR 1 A 5 Other	<1%

In all subcategories SO_2 emissions have decreased steadily mainly due to:

- a lowering of the sulphur content in mineral oil products and fuels (e.g. Fuel Ordinance[102]),
- a switch-over from high sulfur fuels to low-sulphur fuels or to even sulphur free fuel (e.g. natural gas),
- implementation of desulfurisation units in power plants (e.g. LCP directive[103]),
- abatement techniques like combined flue gas treatment.

SO_2 Emission Trends in NFR Category 1 B Fugitive Emissions

This category is a minor source regarding SO_2 emissions, which originate from the first treatment of sour gas. The contribution in the year 1990 was 3%. In 2011, these emissions contributed 1% to national total SO_2 emissions. SO_2 emissions from NFR Category 1 B decreased by 88% between 1990 and 2011 due to the implementation of desulfurisation units.

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[102] BGBl_II_417-04_Kraftstoffverordnung; idF. BGBl. II Nr. 168/2009; Umsetzung der Richtlinie 2003/30/EG

[103] Luftreinhaltegesetzes für Kesselanlagen (LRG-K) BGBl. I Nr. 150/2004 (older version: BGBl. Nr. 380/1988 idF. BGBl. Nr. 185/1993; Umsetzung der Richtlinie 96/61/EG; Richtlinie 96/82/EG, Richtlinie 88/609/EWG, Richtlinie 2001/80/EG, Richtlinie 2002/49/EG

SO_2 Emission Trend in NFR Category 2 Industrial Processes

SO_2 emissions from NFR Category *2 Industrial Processes* decreased over the period from 1990 to 2011. As can be seen in Table 25, in 1990, emissions amounted to 2.2 Gg, in 2011, they were 45% lower (1.2 Gg).

The share of SO_2 emissions from this category in national total emissions was about 3% in 1990 and about 7% in 2011 because there was a strong reduction of SO_2 emissions from combustion processes whereas emissions from industrial processes remained quite stable.

SO_2 emissions arise from the following sub-categories:

	Contribution in Total SO_2 emission (2011)
● NFR 2 B *Chemical Industry* (covers processes in inorganic chemical industries)	4%
● NFR 2 C *Metal Production*	2%

In both subcategories SO_2 emissions have decreased mainly caused by a decline in production and, on the other hand, abatement techniques such as systems for purification of waste gases and desulfurisation facilities.

SO_2 Emission Trend in NFR Category 3 Solvent Use and Other Product Use

No SO_2 emissions occur from NFR 3 Solvent Use and Other Product Use.

SO_2 Emission Trend in NFR Category 4 Agriculture

Field Burning of Agricultural Waste (NFR 4 F) is the only emission source for SO_2 emissions of the Sector *Agriculture*. In 2011, emissions only contribute less than 0.1% to national total SO_2 emissions. Emissions vary on a very small scale following the area of stubble fields burnt each year.

SO_2 Emission Trend in NFR Category 6 Waste

NFR Sector 6 C *Waste incineration (non energy-use)* is the only source of SO_2 emissions. In 1990 national SO_2 emissions of the Sector *Waste* amounted to 0.07 Gg; emissions have decreased until 1992 and then show a steady increase until 1998. Between 1999 and 2005 emissions are stable at a level of 0.06 Gg and then decreased strongly to 0.01 Gg in 2011 due to the waste incineration regulation[104] setting strong emission limits and thus reducing the number of facilities and thus waste incinerated.

In the year 2011 the *Sector Waste* contributed only less than 0.1% to Austria's SO_2 emissions.

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[104] Abfallverbrennungs-(Sammel-)Verordnung (AVV; BGBl. II Nr. 389/2002 i. d. g. F.)

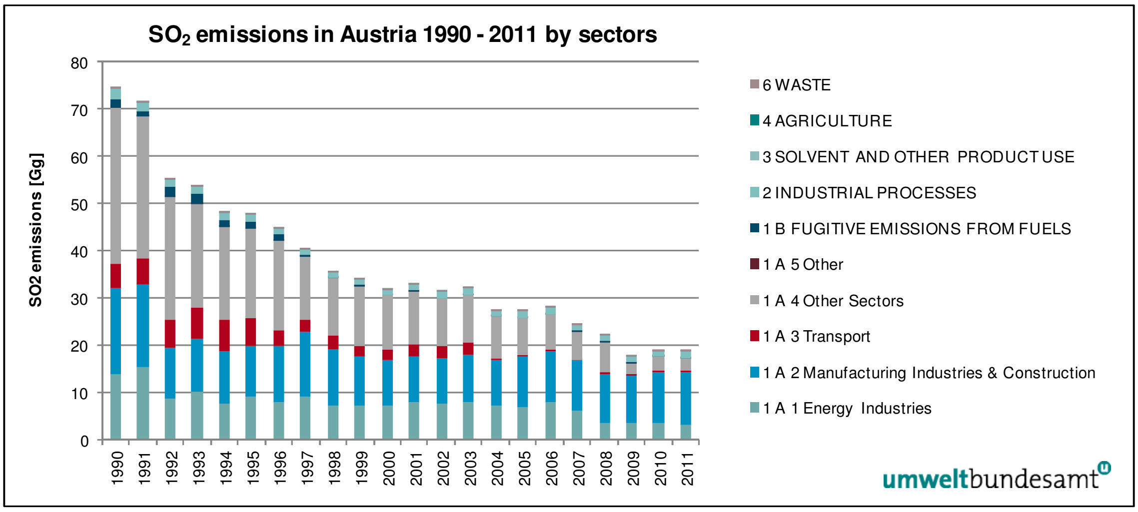

Figure 6: SO_2 emissions in Austria 1990 - 2011 by sectors in absolute terms

Table 25: SO_2 emissions per NFR Category 1990 and 2011, their trends 1990–2011 and their share in total emissions.

NFR Category		**SO_2 Emission in [Gg]**		**Trend**		**Share in National Total**	
		1990	**2011**	**1990–2011**	**2010-2011**	**1990**	**2011**
1	ENERGY	72.16	17.28	-76%	-2%	97%	93%
1 A	FUEL COMBUSTION ACTIVITIES	70.16	17.05	-76%	-2%	94%	92%
1 A 1	Energy Industries	14.04	2.96	-79%	-17%	19%	16%
1 A 1 a	Public Electricity and Heat Production	11.79	2.52	-79%	-14%	16%	14%
1 A 1 b	Petroleum refining	2.25	0.44	-81%	-30%	3%	2%
1 A 1 c	Manufacture of Solid fuels & Other Energy Ind.	0.00	NA	NA	NA	<1%	NA
1 A 2	Manufacturing Industries and Construction	17.97	11.32	-37%	6%	24%	61%
1 A 2 a	Iron and Steel	6.73	5.10	-24%	4%	9%	28%
1 A 2 b	Non-ferrous Metals	0.15	0.08	-47%	-5%	<1%	<1%
1 A 2 c	Chemicals	0.76	0.56	-26%	-9%	1%	3%
1 A 2 d	Pulp, Paper and Print	4.30	1.09	-75%	-7%	6%	6%
1 A 2 e	Food Processing, Beverages and Tobacco	1.65	0.20	-88%	-8%	2%	1%
1 A 2 f	Other	4.39	4.29	-2%	18%	6%	23%
1 A 3	Transport	5.20	0.31	-94%	3%	7%	2%
1 A 3 a	Civil Aviation	0.03	0.11	225%	12%	<1%	1%
1 A 3 b	Road Transportation	4.86	0.13	-97%	-1%	7%	1%
1 A 3 c	Railways	0.26	0.06	-78%	<1%	<1%	<1%
1 A 3 d	Navigation	0.04	0.02	-55%	-11%	<1%	<1%
1 A 3 e	Pipeline compressors	NA	NA	NA	NA	NA	NA
1 A 4	Other Sectors	32.94	2.44	-93%	-15%	44%	13%
1 A 4 a	Commercial/Institutional	5.23	0.34	-94%	-11%	7%	2%
1 A 4 b	Residential	25.93	1.93	-93%	-16%	35%	10%
1 A 4 c	Agriculture/Forestry/Fisheries	1.79	0.18	-90%	-11%	2%	1%
1 A 5	Other	0.01	0.01	18%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	2.00	0.23	-88%	1%	3%	1%
2	INDUSTRIAL PROCESSES	2.22	1.22	-45%	<1%	3%	7%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	1.56	0.77	-51%	<1%	2%	4%
2 C	METAL PRODUCTION	0.66	0.45	-31%	1%	1%	2%
2 C 1	Iron and Steel Production	0.25	0.05	-80%	6%	<1%	<1%
2 C 2	Ferroalloys Production	NA	NA	NA	NA	NA	NA
2 C 3	Aluminium production	NA	NO	NO	NO	NA	NO
2 C 5	Other metal production	0.41	0.40	-1%	<1%	1%	2%
2 D	OTHER PRODUCTION	NA	NA	NA	NA	NA	NA
2 E	PRODUCTION OF POPs	NO	NO	NO	NO	NO	NO
2 F	CONSUMPTION OF POPS & HEAVY METAL	NA	NA	NA	NA	NA	NA
2 G	OTHER PRODUCTION, CONSUMPTION etc.	NA	NA	NA	NA	NA	NA
3	SOLVENT AND OTHER PRODUCT USE	NA	NA	NA	NA	NA	NA
4	AGRICULTURE	0.00	0.00	-50%	-23%	<1%	<1%
6	WASTE	0.07	0.01	-87%	<1%	<1%	<1%
	Total without sinks	**74.45**	**18.51**	**-75%**	**-2%**		

2.1.2 NO_x Emissions

In 1990, national total NO_x emissions amounted to 195 Gg; emissions were slightly decreasing until the mid-1990 but have increased again. After a further significant reduction in 2009 due to the crisis, emissions increased in 2010 and decreased again between 2010 and 2011. In 2011 NO_x emissions were about 7% lower than in 1990.

As can be seen in Table 26, the main source for NO_x emissions in Austria, with a share of 94% in 1990 and 96% in 2011, are the *Fuel Combustion Activities.* Within this source, *road transport*, with about 59% of national total emissions, has the highest contribution to total NO_x emissions.

Please note that emissions from mobile sources are calculated based on fuel sold, which for the last few years is considerably higher than fuel used: emissions for 2011 based on fuel used amount to 144 Gg.

NO_x Emission Trends in Category 1 A Fuel Combustion Activities

As can be seen in Table 26, NO_x emissions from the Sector 1 A *Fuel Combustion Activities* decreased over the period from 1990 to 2011. In 1990, they amounted to 184 Gg. In 2011, they were about 5% lower than 1990 levels (176 Gg). Even if efforts were made regarding emission control in combustion plants, this was counterbalanced by an enormous increase in activity of the transport sector.

The share of NO_x emissions from this category in national total NO_x emissions amounted to about 94% in 1990 and about 96% in 2011. The main source for NO_x emissions in NFR 1 A are:

	Contribution in Total NO_x emission (2011)
● NFR 1 A 1 Energy Industries	7%
● NFR 1 A 2 Manufacturing Industries and Construction	18%
● NFR 1 A 3 Transport	59%
of which Road Transport	*57%*
● NFR 1 A 4 Other Sectors (Comercial, Institutional and Residential heating etc.)	12%
● NFR 1 A 5 Other	<1%

In all subcategories, except NFR 1 A 3 Transport and NFR 1 A 5 Other, NO_x emissions have decreased steadily mainly caused by

- increased efficiency,
- implementation/installation of denitrification installations (DENOX plant) and/or low-NOx burners,
- introduction of modern fuel technology, gas-fired equipments and furnances.

In NFR 1 A 3 *Transport,* the emission reduction measures were the introduction of modern technologies, abatement technologies for gasoline-powered vehicles such as catalysts, switch to more diesel-powered vehicles as well as a regeneration of the vehicle fleet. But in spite of these measures, NO_x emissions have increased by 2% mainly due to the enormous increase in activity of the transport sector in both passenger and freight transport as well as fuel export.

NO_x Emission Trend in NFR Category 2 Industrial Processes

The share of NO_x emissions from this category in national total emissions was about 2% in 1990 and about 1% in 2011 (see Table 26) because of the strong reduction of NO_x emissions in this category but also because the emissions from combustion processes remained quite stable on a high level.

As shown in Table 26, NO_x emissions from the Category 2 *industrial processes* decreased over the period from 1990 to 2011. In 1990 they amounted to 4.8 Gg; in the year 2011, they were 69% below 1990 levels (1.5 Gg).

The relevant sources for NO_x emissions of this NFR Category are:

	Contribution in Total NO_x emission (2011)
● NFR 2 B Chemical Industry (covers processes in inorganic chemical industries)	<1%
● NFR 2 C Metal Production	<1%
● NFR 2 D Other Production (only Pulp and Paper)	1%

However, emissions from this category were reduced due to use of low-emission fuels and energy-savings. Category 2 C Metal Production is only a minor source within this sector.

NO_x Emission Trend in NFR Category 3 Solvent Use and Other Product Use

No NO_x emissions occur from NFR 3 Solvent Use and Other Product Use.

NO_x Emission Trend in NFR Category 4 Agriculture

In 1990, national NO_x emissions of the Sector *Agriculture* amounted to 6.5 Gg, which is a share of about 3% of the Austrian total NO_x emissions. Until 2011, emissions have decreased by 13% and amounted to 5.7 Gg, which is a share in national total NO_x emissions of 3%. This downwards trend is mainly due to reduced use of synthetic N-fertilizers.

	Contribution in Total NO_x emission (2011)
● NFR 4 B Manure Management (Cattle, Sheep, Goats, Horses, Swine, Poultry, Other)	3%
● NFR 4 D Agricultural Soils (nitrogen inputs into Agricultural soils)	<1%
● NFR 4 F Field Burning of Agricultural Residues	<1%
● NFR 4 G Agriculture Other	<1%

NO_x Emission Trend in NFR Category 6 Waste

The share of NO_x emissions from this category in national total emissions was less than 1% in 1990 as well as in 2011. As shown in the table below, NO_x emissions from the waste sector decreased by about 87% over the period from 1990 to 2011 to 0.01 Gg. Emissions result from Waste Incineration (non-energy use).

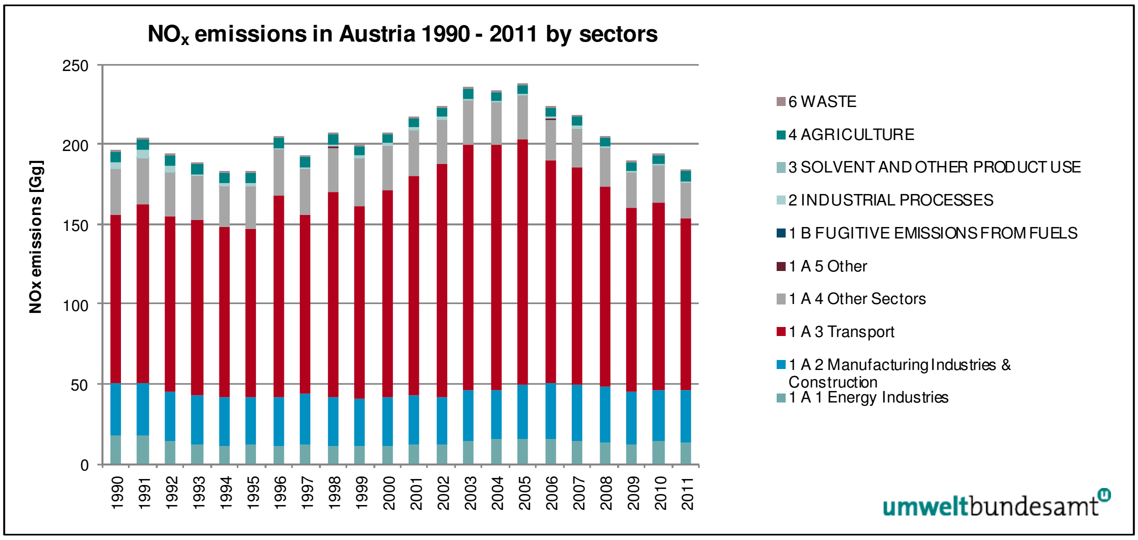

Figure 7: NO_x emissions in Austria 1990 - 2011 by sectors in absolute terms

Table 26: NO_x emissions per NFR Category 1990 and 2011, their trend 1990–2011 and their share in total emissions.

NFR Category		NO_x Emission in [Gg]		Trend		Share in National Total	
		1990	2011	1990–2011	2010–2011	1990	2011
1	ENERGY	184.06	175.53	-5%	-6%	94%	96%
1 A	FUEL COMBUSTION ACTIVITIES	184.06	175.53	-5%	-6%	94%	96%
1 A 1	Energy Industries	17.74	13.58	-23%	-3%	9%	7%
1 A 1 a	Public Electricity and Heat Production	12.05	11.06	-8%	-4%	6%	6%
1 A 1 b	Petroleum refining	4.32	0.90	-79%	-14%	2%	<1%
1 A 1 c	Manufacture of Solid fuels & Other Energy Ind.	1.37	1.63	18%	21%	1%	1%
1 A 2	Manufacturing Industries and Construction	32.97	32.28	-2%	<1%	17%	18%
1 A 2 a	Iron and Steel	5.41	4.32	-20%	-2%	3%	2%
1 A 2 b	Non-ferrous Metals	0.25	0.21	-19%	-2%	<1%	<1%
1 A 2 c	Chemicals	1.69	1.30	-23%	-1%	1%	1%
1 A 2 d	Pulp, Paper and Print	7.00	5.06	-28%	-2%	4%	3%
1 A 2 e	Food Processing, Beverages & Tobacco	1.74	0.78	-55%	-8%	1%	<1%
1 A 2 f	Other	16.88	20.61	22%	2%	9%	11%
1 A 3	Transport	105.55	108.13	2%	-7%	54%	59%
1 A 3 a	Civil Aviation	0.41	1.28	215%	13%	<1%	1%
1 A 3 b	Road Transportation	102.25	103.56	1%	-8%	52%	57%
1 A 3 c	Railways	1.82	1.66	-9%	-2%	1%	1%
1 A 3 d	Navigation	0.46	0.56	22%	-11%	<1%	<1%
1 A 3 e	Pipeline compressors	0.61	1.06	75%	23%	<1%	1%
1 A 4	Other Sectors	27.73	21.46	-23%	-7%	14%	12%
1 A 4 a	Commercial/Institutional	3.38	1.90	-44%	-11%	2%	1%
1 A 4 b	Residential	13.88	10.87	-22%	-12%	7%	6%
1 A 4 c	Agriculture/Forestry/Fisheries	10.47	8.69	-17%	2%	5%	5%
1 A 5	Other	0.07	0.08	10%	<1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	IE	IE	IE	IE	IE	IE
2	INDUSTRIAL PROCESSES	4.80	1.50	-69%	1%	2%	1%
2 B	CHEMICAL INDUSTRY	4.07	0.38	-91%	-10%	2%	<1%
2 C	METAL PRODUCTION	0.17	0.11	-37%	7%	<1%	<1%
2 D	OTHER PRODUCTION	0.55	1.01	84%	4%	<1%	1%
2 E	PRODUCTION OF POPs	NO	NO	NO	NO	NO	NO
2 F	CONSUMPTION OF POPS AND HEAVY METAL	NA	NA	NA	NA	NA	NA
2 G	OTHER PRODUCTION, CONSUMPTION etc.	NA	NA	NA	NA	NA	NA
3	SOLVENT AND OTHER PRODUCT USE	NA	NA	NA	NA	NA	NA
4	AGRICULTURE	6.51	5.66	-13%	1%	3%	3%
4 B	MANURE MANAGEMENT	5.10	4.58	-10%	-1%	3%	3%
4 D	AGRICULTURAL SOILS	1.35	1.02	-24%	17%	1%	1%
4 F	FIELD BURNING OF AGRICULTURAL RESIDUE	0.03	0.01	-58%	-31%	<1%	<1%
4 G	Agriculture OTHER	0.04	0.05	34%	-5%	<1%	<1%
6	WASTE	0.10	0.01	-87%	<1%	<1%	<1%
	Total without sinks	**195.47**	**182.71**	**-7%**	**-5%**		

2.1.3 NMVOC Emissions

In 1990, national total NMVOC emissions amounted to 274 Gg; emissions have decreased steadily since then and by the year 2011 emissions were reduced by 53%. The significant reduction due to the economical crisis in 2009 is partly counterbalanced by the rebound of the economy in 2010.

As can be seen in Table 27, in 2011 the main sources of NMVOC emissions in Austria are *Fuel Combustion Activities* with a share of 37%, and *Solvent and Other Product Use* with a contribution to the national total of 57%.

NMVOC emissions decreased notable in both main categories: the reduction in the energy sector is due to decreasing emissions from road transport because of low emission combustion and also from residential heating, due to the replacement of ineffective heating systems.

The reduction in Sector *Solvent and Other Product Use* is due to legal abatement measures such exhaust systems and aftertreatment.

NMVOC Emission Trends in NFR Category 1 A Fuel Combustion Activities

In 2011, NFR Category *1 A* was the second largest category regarding NMVOC emissions in Austria. In 1990 the contribution to national total emissions was 49% (136 Gg), compared to 37% (47 Gg) in 2011 due to exhaust-gas limits for vehicles and increasing number of diesel-driven vehicles as well as applied abatement techniques and improved biomass heatings in households.

NMVOC emissions from NFR 1 A are continuously decreasing: in the period from 1990 to 2011 emissions decreased by 65%, mainly due to decreasing emissions from NFR *1 A 3 Transport* and NFR *1 A 4 Other Sectors*.

NMVOC Emission Trends in NFR Category 1 B Fugitive Emissions

NMVOC emissions from this category are a minor source of NMVOC emissions in Austria: in 1990 the contribution to national total emissions was 5%, in the year 2011 it was 2%. Fugitive NMVOC emissions decreased: in 2011, they were 85% below 1990 levels.

NMVOC Emission Trend in NFR Category 2 Industrial Processes

NFR category *2 Industrial processes* is the third largest category regarding NMVOC emissions. In 1990, the contribution to national total emissions was 4% (11 Gg) as well as in the year 2011 with also 4% (5 Gg). The decrease is mainly due to abatement techniques in this sector but also because of decreasing emissions from other categories such as NFR *3 Solvents* or NFR *1 Energy*.

The trend regarding NMVOC emissions from NFR *2 Industrial Processes* shows decreasing emissions: in the period from 1990 to 2011 emissions decreased by 56%, mainly due to decreasing emissions from NFR *2 B Chemical Industry.*

In 2011 the relevant sources for NMVOC emissions of NFR Category 2 Industrial Processes are:

	Contribution in Total NO_x emission (2011)
● NFR 2 B Chemical Industry (covers processes in inorganic chemical industries)	1%
● NFR 2 C Metal Production	<1%
● NFR 2 D Other Production (Pulp and Paper (chipboard industry) as well as Food and Drink)	2%

As can be seen in Table 27 and in NFR for 2011 (chapter 12.1) NMVOC emissions of NFR 2 A and NFR 2 B 1 are included elsewhere (IE):

- NMVOC emissions from NFR 2 A, which covers activities form road paving with asphalt, are reported in NFR 3.
- NMVOC emissions from NFR 2 B 1, which covers activities form Ammonia Production, are reported in NFR 2 B 5 Other.

NMVOC Emission Trend in NFR Category 3 Solvent and Other Product Use

NFR Category 3 *Solvent and Other Product Use* is the largest Sector regarding NMVOC emissions and thus also a key category; in 1990, the contribution to national total emissions was 41% (114 Gg) compared to 57% (73 Gg) in 2011 also due to decreasing emissions from other categories such as NFR 2 *Industrial Processes* and NFR 1 *Energy*.

The trend regarding NMVOC emissions from NFR 3 *Solvent and Other Product Use* shows decreasing emissions: in the period from 1990 to 2011 emissions decreased by 37%, mainly due to decreasing emissions from NFR 3 *A Paint Application*. This reduction was primarily achieved from 1990 to 2000 due to various legal and regulatory enforcements.[105] The significant reduction due to the economical crisis in 2009 is partly counterbalanced by the rebound of the economy.

- NMVOC emissions from NFR *3 A Paint Applications,* which had a share of 28% in NFR 3, arose from the following sub categories:
  - NFR 3 A 1 *Decorative Paint Application*, which covers the use of paint in the area of construction and buildings and for domestic use (except do-it-yourself). NMVOC emissions decreased by 44% to about 9 Gg in the period 1990–2011 due the reduction of solvents in paint as well as due to substitution of solvent-based paint for paint with less or without solvents,
  - NFR 3 A 2 *Industrial Paint Application,* which covers processes such as car repairing, coil coating, wood conditioning and other industrial paint applications. The NMVOC emissions decreased by 61% to about 12 Gg in the period 1990-2011, but the reduction in emissions occured mainly from 1990 to 1999 due to different enforced laws and regulations various legal and regulatory enforcements and due to a reduction of solvents in paint as well as due to substitution solvent-based paint for paint with less or without solvents. Since then the emissions remained almost stable or even increased due to intensified activities which compensate the measures.

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[105] see Chapter 5.1

- NMVOC emissions from sub sector *3 B Degreasing and Dry Cleaning,* which had a share of 8% in National Total NMVOC emission, arose in 2011 from the following sub categories:
  - NFR 3 B 1 Degreasing, where the emissions decreased by 28% to about 10 Gg,
  - NFR 3 B 2 Dry Cleaning, where the emissions decreased by 12% to 0.3 Gg.

  The emission reduction in this sub sector could be achieved due to technical abatement measures such as closed loop processes, waste gas purification and recycling. The quantity of used solvents increased within the period 1990–2011, which compansates the reduction due to technical abatement measures.
- The share of NMVOC emissions from sub sector NFR 3 C *Chemical Products* in national total emissions was about 5% in 1990 as well as 5% in 2011, whereas an emission reduction of 52% could be achieved due to technical abatement measures such as closed loop processes, waste gas purification and recycling but also due to product substitution. The NFR 3 C covers activities such as rubber processing, asphalt blowing, textile finishing and leather tanning as well as the manufacturing of pharmaceutical products, paints, inks and glues.
- The share of NMVOC emissions from sub sector NFR 3 D *Other* in category NFR 3 is about 15% in 1990 and about 28% in 2011. In 2011 the relevant sources for NMVOC emissions of NFR 3 D *Other* are:

	Contribution in Total NMVOC emission (2011)
● NFR 3 D 1 Printing	5%
● NFR 3 D 2 Domestic solvent use including fungicides	13%
● NFR 3 D 3 Other product use	10%

  However, in NFR 3 D 2 Domestic solvent use (including fungicides) an emission increase of 46% could be noted.
- The emission reduction could be achieved due to technical abatement measures such as closed loop processes, waste gas purification and recycling. The high increase of the NMVOC emissions in category 3 D 2 until 2006 is due to a considerable increase of do-it-yourself activities. After a strong decrease between the years 2008 and 2009 due to the economic crisis, the NMVOC emissions increased again by 13% between 2009 and 2011 as a result of the economic recovery.

NMVOC Emission Trend in NFR Category 4 Agriculture

In 2011 NMVOC emissions of category Agriculture only contributed 2% (2.0 Gg) to the Austrian total NMVOC emissions. From 1990 to 2011 NMVOC from Agriculture increased by 5%.

	Contribution in Total NMVOC emission (2011)
● NFR 4 F Field Burning of Agricultural Residues	<1%
● NFR 4 G Agriculture Other (use of sewage sludge)	1%

NMVOC Emission Trend in NFR Category 6 Waste

In 2011, NMVOC emissions from category *Waste* contributed less than 0.1% (0.06 Gg) to Austria's total NMVOC emissions. From 1990 to 2011 NMVOC from NFR Sector 6 *Waste* decreased by 64%. In 2011, 98% of the NMVOC emissions from the Sector Waste arose from NFR Sector 6 A Solid Waste Disposal on Land.

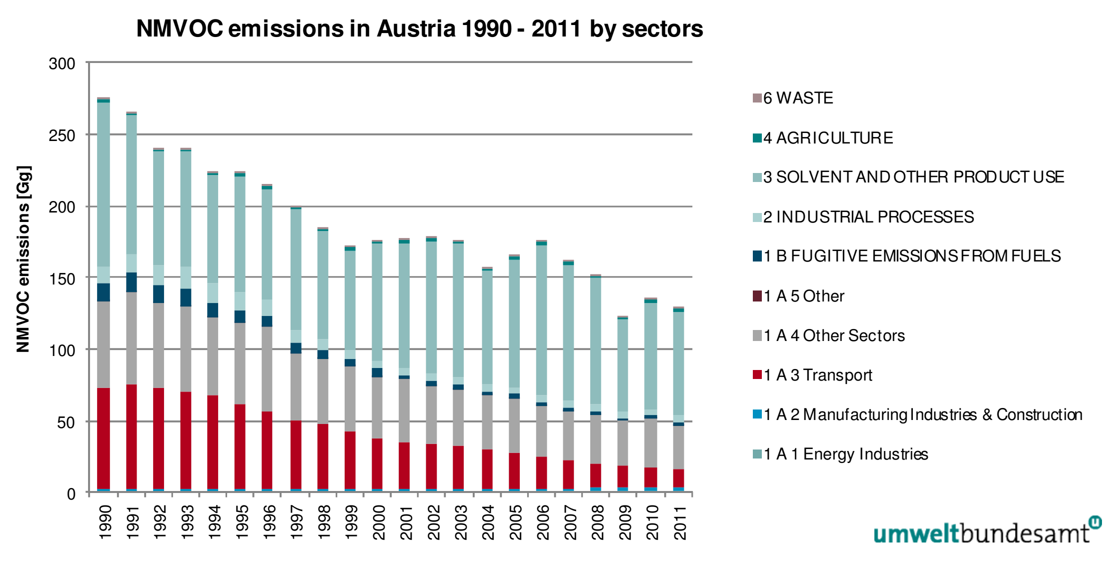


Figure 8: NMVOC emissions in Austria 1990 - 2011 by sectors in absolute terms

Table 27: NMVOC emissions per NFR Category 1990 and 2011, their trend 1990–2011 and their share in total emissions.

NFR Category		NMVOC Emission in [Gg]		Trend		Share in National Total	
		1990	2011	1990–2011	2010–2011	1990	2011
1	ENERGY	146.30	48.71	-67%	-9%	53%	38%
1 A	FUEL COMBUSTION ACTIVITIES	133.68	46.79	-65%	-9%	49%	37%
1 A 1	Energy Industries	0.42	0.95	127%	7%	<1%	1%
1 A 2	Manufacturing Industries and Construction	1.74	2.44	41%	2%	1%	2%
1 A 3	Transport	70.23	13.45	-81%	-8%	26%	10%
1 A 3 a	Civil Aviation	0.20	0.56	174%	15%	<1%	<1%
1 A 3 b	Road Transportation	69.15	12.37	-82%	-9%	25%	10%
1 A 3 c	Railways	0.37	0.25	-32%	-2%	<1%	<1%
1 A 3 d	Navigation	0.52	0.27	-48%	-6%	<1%	<1%
1 A 3 e	Pipeline compressors	0.00	0.00	75%	23%	<1%	<1%
1 A 4	Other Sectors	61.28	29.92	-51%	-11%	22%	24%
1 A 4 a	Commercial/Institutional	0.67	0.47	-30%	-15%	<1%	<1%
1 A 4 b	Residential	56.00	24.64	-56%	-13%	20%	19%
1 A 4 c	Agriculture/Forestry/Fisheries	4.60	4.82	5%	-2%	2%	4%
1 A 5	Other	0.01	0.02	9%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	12.62	1.93	-85%	-4%	5%	2%
2	INDUSTRIAL PROCESSES	11.10	4.91	-56%	5%	4%	4%
2 A	MINERAL PRODUCTS	IE	IE	IE	IE	IE	IE
2 B	CHEMICAL INDUSTRY	8.29	1.32	-84%	<1%	3%	1%
2 C	METAL PRODUCTION	0.52	0.45	-13%	6%	<1%	<1%
2 D	OTHER PRODUCTION	2.29	3.13	37%	7%	1%	2%
2 E	PRODUCTION OF POPs	NO	NO	NO	NO	NO	NO
2 F	CONSUMPTION OF POPS & HEAVY METAL	NA	NA	NA	NA	NA	NA
2 G	OTHER PRODUCTION, CONSUMPTION etc.	NA	NA	NA	NA	NA	NA
3	SOLVENT AND OTHER PRODUCT USE	114.43	72.53	-37%	-2%	41%	57%
3 A	PAINT APPLICATION	45.79	20.36	-56%	-2%	17%	16%
3 B	DEGREASING AND DRY CLEANING	13.70	9.96	-27%	-2%	5%	8%
3 C	3 C Chemical products	12.79	6.15	-52%	-2%	5%	5%
3 D	OTHER including products containing HMs and POPs	42.15	36.05	-14%	-2%	15%	28%
4	AGRICULTURE	1.85	1.95	5%	10%	1%	2%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRICULTURAL RESIDU	0.14	0.08	-44%	-22%	<1%	<1%
4 G	AGRICULTURE OTHER	1.72	1.88	9%	11%	1%	1%
6	WASTE	0.16	0.06	-64%	-7%	<1%	<1%
6 A	SOLID WASTE DISPOSAL ON LAND	0.15	0.06	-62%	-7%	<1%	<1%
6 B	WASTEWATER HANDLING	NA	NA	NA	NA	NA	NA
6 C	WASTE INCINERATION	0.01	0.00	-91%	<1%	<1%	<1%
6 D	OTHER WASTE	NA	NA	NA	NA	NA	NA
	Total without sinks	**273.84**	**128.17**	**-53%**	**-5%**		

2.1.4 NH_3 Emissions

In 1990, national total NH_3 emissions amounted to 65 Gg; emissions have slightly decreased over the period from 1990 to 2011. In 2011, emissions were 5% below 1990 levels. As can be seen in Table 28, NH_3 emissions in Austria are almost exclusively emitted by the agricultural sector. The share in national total NH_3 emissions is about 93% for 2011. Within this source manure management – cattle has the highest contribution to national total NH_3 emissions.

NH_3 Emission Trends in NFR Category 1 A Fuel Combustion Activities

NH_3 emissions from NFR *1 A* is the second largest category regarding NH_3 emissions but this category is only a minor source of NH_3 emissions with a contribution to national total NH_3 emissions of 4% in 2011. NH_3 emissions from NFR *1* A are decreasing: in 1990, emissions amounted to about 4.1 Gg. In the year 2011, they were about 36% lower than 1990 levels and amounted to about 2.6 Gg.

NH_3 Emission Trend in NFR Category 2 Industrial Processes

NH_3 emissions from NFR 2 *Industrial Processes* nearly exclusively arise from NFR Category *2 B Chemical Products*, which is only a minor source of NH_3 emissions with a contribution to national total emissions of 0.4% in 1990 and 0.2% in 2011 respectively.

The trend concerning NH_3 emissions from NFR 2 *Industrial Processes* is generally decreasing: in the period from 1990 to 2011 emissions decreased by 63% from 0.27 Gg in 1990 to 0.10 Gg (see Table 28). Extensive abatement techniques are the reasons for the emission reduction.

NH_3 emissions of NFR 2 C *Metal Production* are included in NFR 1 A 2 a *Manufacturing Industries and Construction - Iron and Steel.*

NH_3 Emission Trend in NFR Category 3 Solvent Use and Other Product Use

No NH_3 emissions occur from NFR 3 Solvent Use and Other Product Use.

NH_3 Emission Trend in NFR Category 4 Agriculture

In 1990 national NH_3 emissions from the Sector *Agriculture* amounted to 60.7 Gg; emissions have decreased since then and by the year 2011 emissions were reduced by 4% to 58.2 Gg mainly due to decreasing animal numbers. In 2011 the category *Agriculture* contributed 93% to Austria's NH_3 emissions (see Table 28).

Within this category:

- *Manure Management* (NFR 4 B), with a share of 84%, has the highest contribution to national total NH_3 emissions in 2011. The agricultural NH_3 emissions result from animal husbandry, the storage of manure as well as the application of organic manure. The decreasing or increasing emissions are mainly due to declining or increasing lifestock.
  - NFR *4 B 1 Cattle* share of 56% in National Total NH_3 emission and an emission reduction of 2% (35 Gg);
  - NFR *4 B 8 Swine* share of 17% in National Total NH_3 emission and an emission reduction of 19% (11 Gg);
  - NFR 4 B 9 Poultry share of 9% in National Total NH_3 emission and an emissions increase of 6% (6 Gg);
  - All other categories (NFR *4 B 3 Sheep,* NFR *4 B 4 Goats,* NFR *4 B 6 Horses,* NFR *4 B 13 Other) have together* a share of 1% in National Total NH_3 emission.
- *Agricultural Soils* (NFR 4 D) has a share of 9% in national total NH_3 emissions in 2011. These emissions result from fertilisation with mineral N-fertilisers. Other sources of NH_3 emissions are biological nitrogen fixation (legume crops) and manure excreted on pastures by grazing animals.
  - 4 D 1 *Direct* Soil Emissions: share of 7% in National Total NH_3 and an emissions increase of 16% (4.4 Gg);
  - 4 D 2 Soil operations: share of 2% in National Total NH_3 and an emissions reduction of 25% (1.0 Gg);
- *Field burning of agricultural residues* (NFR 4 F): NH_3 emissions are negligible low (<0.1% to total NH_3 emissions in 2011).

NH_3 Emission Trend in NFR Category 6 Waste

In 1990 national NH_3 emissions of the Sector *Waste* amounted to about 0.4 Gg; emissions increased by about 289% to 1.4 Gg in 2011 mainly due to increasing mechanical biological treatment of waste and collection of bio-waste, lopping etc. In the year 2011 the Sector W*aste* contributed 2% to Austria's NH_3 emissions.

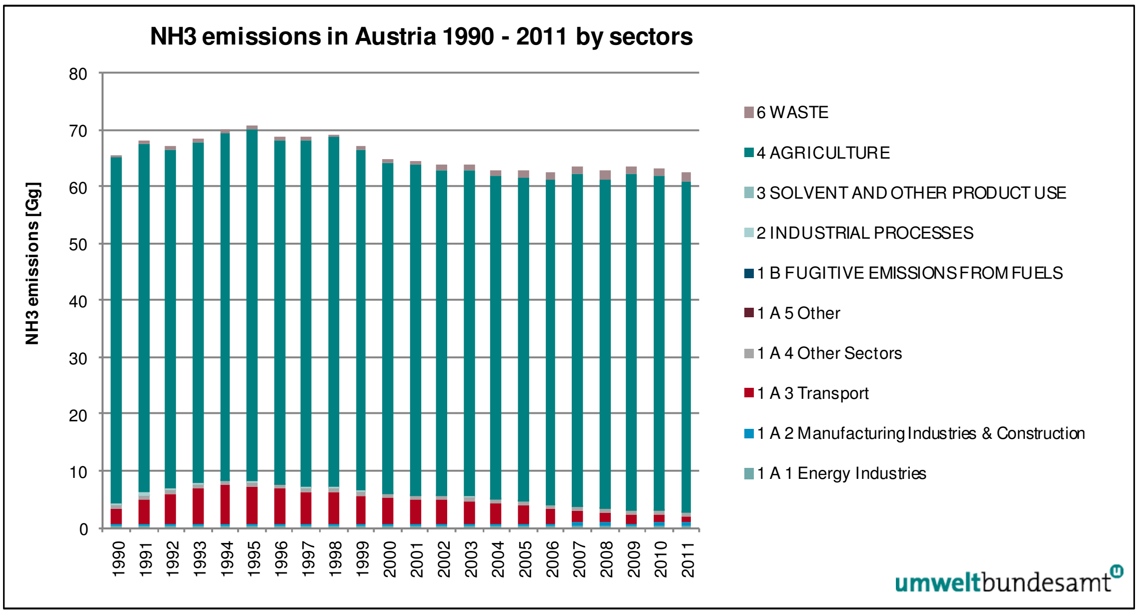


Figure 9: NH_3 emissions in Austria 1990 - 2011 by sectors in absolute terms

Table 28: NH_3 emissions per NFR Category 1990 and 2011, their trend 1990 – 2011 and their share in total emissions.

NFR Category		**NH_3 Emission in [Gg]**		**Trend**		**Share in National Total**	
		1990	**2011**	**1990–2011**	**2010–2011**	**1990**	**2011**
1	ENERGY	4.05	2.59	-36%	-10%	6%	4%
1 A	FUEL COMBUSTION ACTIVITIES	4.05	2.59	-36%	-10%	6%	4%
1 A 1	Energy Industries	0.20	0.47	130%	-7%	<1%	1%
1 A 2	Manufacturing Industries and Construction	0.35	0.42	22%	-3%	1%	1%
1 A 3	Transport	2.88	1.09	-62%	-13%	4%	2%
1 A 4	Other Sectors	0.63	0.62	-2%	-11%	1%	1%
1 A 5	Other	0.00	0.00	19%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	IE	IE	IE	IE	IE	IE
2	INDUSTRIAL PROCESSES	0.27	0.10	-62%	11%	<1%	<1%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	0.27	0.10	-63%	12%	<1%	<1%
2 C	METAL PRODUCTION	IE	IE	IE	IE	IE	IE
2 E	PRODUCTION OF POPs	NA	NA	NA	NA	NA	NA
2 F	CONSUMPTION OF POPS AND HEAVY METAI	NO	NO	NO	NO	NO	NO
2 G	OTHER PRODUCTION, CONSUMPTION etc.	NA	NA	NA	NA	NA	NA
3	SOLVENT AND OTHER PRODUCT USE	0.00	0.00	<1%	<1%	<1%	<1%
4	AGRICULTURE	NA	NA	NA	NA	NA	NA
4 B	MANURE MANAGEMENT	60.70	58.25	-4%	-1%	93%	93%
4 B 1	Cattle	55.12	52.27	-5%	-2%	84%	84%
4 B 2	Buffalo	35.68	34.91	-2%	-1%	55%	56%
4 B 3	Sheep	NO	NO	NO	NO	NO	NO
4 B 4	Goats	0.14	0.17	17%	1%	<1%	<1%
4 B 5	Camels and Llamas	0.02	0.03	94%	1%	<1%	<1%
4 B 6	Horses	NO	NO	NO	NO	NO	NO
4 B 7	Mules and Asses	0.25	0.42	66%	<1%	<1%	1%
4 B 8	Swine	IE	IE	IE	IE	IE	IE
4 B 9	Poultry	13.52	10.90	-19%	-3%	21%	17%
4 B-13	Other	5.49	5.82	6%	<1%	8%	9%
4 D	AGRICULTURAL SOILS	0.02	0.02	28%	<1%	<1%	<1%
4 D 1	Direct Soil Emissions	5.12	5.38	5%	5%	8%	9%
4 D 2	Soil operations	3.77	4.36	16%	6%	6%	7%
4 F	FIELD BURNING OF AGRICULTURAL RESIDU	1.35	1.01	-25%	<1%	2%	2%
4 G	Agriculture OTHER	0.04	0.02	-52%	-24%	<1%	<1%
6	WASTE	0.43	0.59	37%	-2%	1%	1%
6 A	SOLID WASTE DISPOSAL ON LAND	0.36	1.40	289%	<1%	1%	2%
6 B	WASTEWATER HANDLING	0.00	0.00	-62%	-7%	<1%	<1%
6 C	WASTE INCINERATION	NA	NA	NA	NA	NA	NA
6 D	OTHER WASTE	0.00	0.00	-78%	<1%	<1%	<1%
	Total without sinks	**65.39**	**62.33**	**-5%**	**-1%**		

2.1.5 Carbon monoxide (CO) Emissions

CO is a colourless and odourless gas, formed when carbon in fuel is not burned completely. It is a component of motor vehicle exhaust; other sources of CO emissions include industrial processes, non-transportation fuel combustion, and natural sources such as wildfires. Peak CO concentrations typically occur during the colder months of the year when CO automotive emissions are greater and night-time inversion conditions are more frequent.

In 1990, national total CO emissions amounted to 1 436 Gg; emissions have considerably decreased over the period from 1990 to 2011. In 2011, emissions were with 609 Gg 58% below 1990 levels and also below the level of 2009 (economic crisis) mainly due to decreasing consumption of fossil fuels because of mild temperatures.

As can be seen in Table 29, CO emissions in Austria are almost exclusively emitted by the energy sector, and more specifically, fuel combustion activities. The share in national total CO emissions is about 96% for 1990 and 95% for 2011. Emissions decreased mainly due to decreasing emissions from road transport and residential heating, which is due to the switch-over to improved technologies.

CO Emission Trends in Category 1 A Fuel Combustion Activities

NFR 1 A Fuel Combustion Activities is the largest category regarding CO emissions. As can be seen in Table 29, over the period 1990–2011 the CO emissions from *Fuel Combustion Activities* decreased by 58%. CO emissions amounted to about 1 378 Gg in 1990 and to about 580 Gg in 2011. The main source for CO emissions in NFR 1 A in 2011 are:

	Contribution in Total CO emission (2011)
● NFR 1 A 1 Energy Industries	1%
● NFR 1 A 2 Manufacturing Industries and Construction *of which Iron and Steel*	25% *20%*
● NFR 1 A 3 Transport *of which Road Transport*	24% *23%*
● NFR 1 A 4 Other Sectors (Comercial, Institutional and Residential heating etc.)	45%

In the period 1990–2011, the share of CO emissions from this category in national total emissions has been stable in spite of growing activities because of considerable efforts regarding abatement techniques and improved combustion efficiency in all sub-sectors. The emission reduction is mainly possible due to optimised combustion technology and introduction of catalyst (transport sector).

CO Emission Trend in NFR Category 2 Industrial Processes

The share of CO emissions from this category in national total emissions was about 3% in 1990 and about 4% in 2011 (see Table 29) because of the strong reduction measures for CO emissions in this category but also because the emissions from combustion processes remained on a relatively high level.

As it can be seen in Table 29, CO emissions from the *industrial processes sector* decreased over the period from 1990 to 2011. In 1990, they amounted to 46 Gg. In the year 2011, they were 48% below 1990 levels (24 Gg).

The relevant sources for CO emissions of this NFR Category are:

	Contribution in Total CO emission (2011)
● NFR 2 A Mineral Products	2%
● NFR 2 B Chemical Industry (mainly processes in inorganic chemical industries)	2%
● NFR 2 C Metal Production	<1%
● NFR 2 D Other Production (only Pulp and Paper)	<1%

Extensive technical abatement techniques as well as energy-saving technology are reasons for the emission reduction.

CO Emission Trend in NFR Category 3 Solvent Use and Other Product Use

No CO emissions occur from NFR 3 Solvent Use and Other Product Use.

CO Emission Trend in NFR Category 4 Agriculture

NFR 4 F *Field Burning of Agricultural Waste* is the only emission source for CO emissions of the Sector *Agriculture*. In 2011, emissions only contributed 0.1% (0.5 Gg) to national total emissions. Emissions vary on a very small scale with the area of stubble fields burnt each year.

CO Emission Trend in NFR Category 6 Waste

In 2011, CO emissions of category *Waste* only contributed about 1% (4.2 Gg) to the Austrian total CO emissions. From 1990 to 2011, CO emissions from NFR Sector 6 *WASTE* decreased by about 62%.

The relevant sources for CO emissions of this NFR Category are:

	Contribution in Total CO emission (2011)
● NFR 6 A Solid Waste Disposal on Land	1%
● NFR 6 C WASTE INCINERATION (without energy recovery)	<0.1%

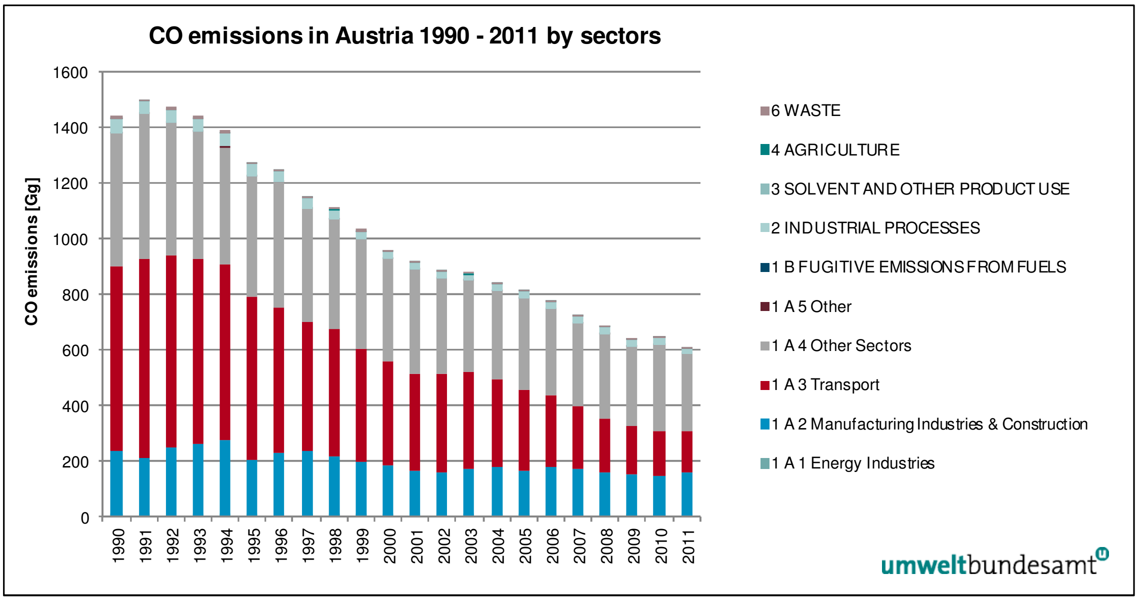


Figure 10: CO emissions in Austria 1990 - 2011 by sectors in absolute terms

Table 29: CO emissions per NFR Category 1990 and 2011, their trend 1990–2011 and their share in total emissions.

NFR Category		CO Emission in [Gg]		Trend		Share in National Total	
		1990	2011	1990–2011	2010-2011	1990	2011
1	ENERGY	1 377.87	580.11	-58%	-6%	96%	95%
1 A	FUEL COMBUSTION ACTIVITIES	1 377.87	580.11	-58%	-6%	96%	95%
1 A 1	Energy Industries	6.07	5.74	-5%	-5%	<1%	1%
1 A 2	Manufacturing Industries and Construction	230.75	153.23	-34%	11%	16%	25%
1 A 2 a	Iron and Steel	210.72	120.85	-43%	12%	15%	20%
1 A 2 b	Non-ferrous Metals	0.05	0.04	-15%	3%	<1%	<1%
1 A 2 c	Chemicals	0.80	1.33	67%	<1%	<1%	<1%
1 A 2 d	Pulp, Paper and Print	4.08	2.14	-48%	<1%	<1%	<1%
1 A 2 e	Food Processing, Beverages and Tobacco	0.20	0.13	-34%	-8%	<1%	<1%
1 A 2 f	Other	14.91	28.75	93%	6%	1%	5%
1 A 3	Transport	658.68	147.21	-78%	-9%	46%	24%
1 A 3 a	Civil Aviation	2.47	5.28	114%	37%	<1%	1%
1 A 3 b	Road Transportation	651.07	138.09	-79%	-10%	45%	23%
1 A 3 c	Railways	2.04	1.46	-29%	-2%	<1%	<1%
1 A 3 d	Navigation	3.06	2.31	-24%	-4%	<1%	<1%
1 A 3 e	Pipeline compressors	0.04	0.07	75%	23%	<1%	<1%
1 A 4	Other Sectors	482.16	273.65	-43%	-11%	34%	45%
1 A 4 a	Commercial/Institutional	11.33	6.16	-46%	-13%	1%	1%
1 A 4 b	Residential	437.97	238.19	-46%	-12%	30%	39%
1 A 4 c	Agriculture/Forestry/Fisheries	32.86	29.31	-11%	-6%	2%	5%
1 A 5	Other	0.22	0.28	27%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	IE	IE	IE	IE	IE	IE
2	INDUSTRIAL PROCESSES	46.37	23.95	-48%	<1%	3%	4%
2 A	MINERAL PRODUCTS	9.78	9.78	<1%	<1%	1%	2%
2 B	CHEMICAL INDUSTRY	12.67	11.12	-12%	<1%	1%	2%
2 C	METAL PRODUCTION	23.52	2.31	-90%	3%	2%	<1%
2 D	OTHER PRODUCTION	0.40	0.74	84%	4%	<1%	<1%
2 E	PRODUCTION OF POPs	NO	NO	NO	NO	NO	NO
2 F	CONSUMPTION OF POPS & HEAVY METAL	NA	NA	NA	NA	NA	NA
2 G	OTHER PRODUCTION, CONSUMPTION etc.	NA	NA	NA	NA	NA	NA
3	SOLVENT AND OTHER PRODUCT USE	NA	NA	NA	NA	NA	NA
4	AGRICULTURE	0.99	0.50	-50%	-23%	<1%	<1%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRICULT. RESIDUES	0.99	0.50	-50%	-23%	<1%	<1%
4 G	AGRICULTURE OTHER	NA	NA	NA	NA	NA	NA
6	WASTE	11.16	4.21	-62%	-7%	1%	1%
6 A	SOLID WASTE DISPOSAL ON LAND	11.11	4.20	-62%	-7%	1%	1%
6 B	WASTEWATER HANDLING	NA	NA	NA	NA	NA	NA
6 C	WASTE INCINERATION	0.05	0.01	-82%	<1%	<1%	<1%
6 D	OTHER WASTE	NA	NA	NA	NA	NA	NA
	Total without sinks	**1 436.40**	**608.77**	**-58%**	**-6%**		

2.2 Emission Trends for Particulate matter (PM)

Dust is a complex mixture consisting of both directly emitted and secondarily formed components of both natural and anthropogenic origin (e.g. dust, geological material, abraded particles and biological material) and has a rather inhomogeneous composition of sulphate, nitrate, ammonium, organic carbon, heavy metals, PAH and dioxins/ furans (PCDD/F). PM is either formed during industrial production and combustion processes as well as during mechanical processes such as abrasion of surface materials and generation of fugitive dust or by secondary formation from SO_2, NO_x, NMVOC or NH_3.

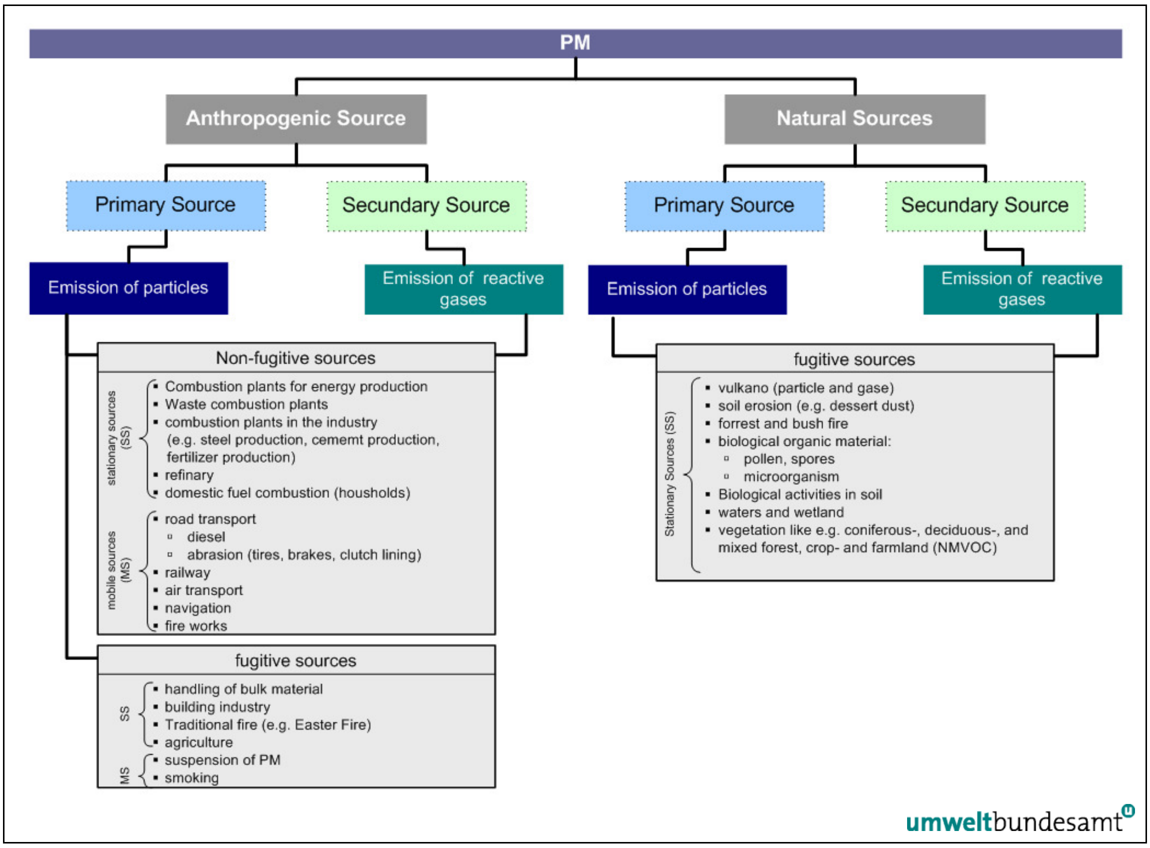


Figure 11: Schematic classification of PM sources.

PM does not only have effects on the chemical composition and reactivity of the atmosphere but also affects human and animal health and welfare. When breathed in, a particle-loaded atmosphere impacts on the respiratory tract. The observable effects are dependent on the particle size, that's why for legislative issues particulate matter (PM) is classified according to its size (see Figure 12).

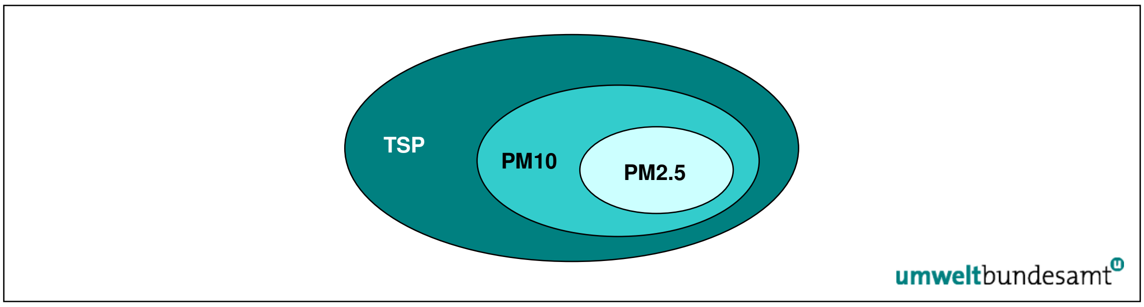


Figure 12: Distribution of TSP, PM10 and PM2.5 (schematic).

TSP emissions in Austria derive from industrial processes, road transport, agriculture and small heating installations. Fine particles often have a seasonal pattern: Whereas PM2.5 values are typically higher in the season when sulfates are more readily formed from SO_2 emissions from power plants, PM10 concentrations tend to be higher in the fourth calendar quarter because fine particle nitrates are more readily formed in cooler weather, and wood stove and fireplace use produces more carbon.

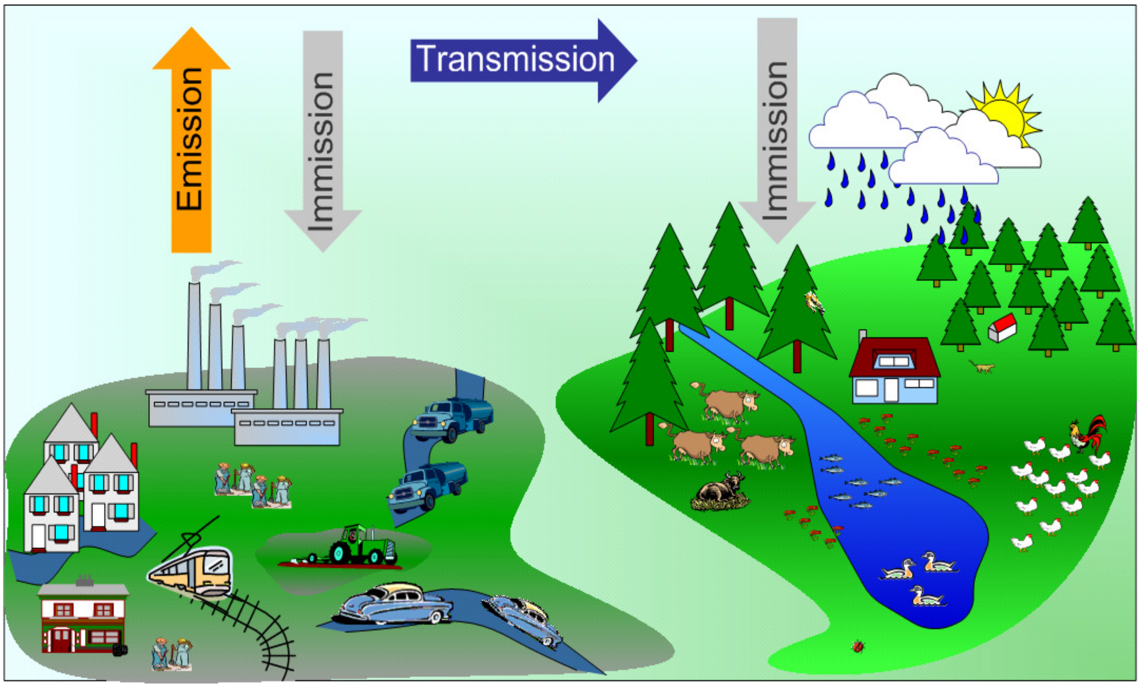


Figure 13: Interrelation of emission, transmission and immission.

Particulate matter (PM) emissions remained quite stable over the period 1990 to 2011: TSP emissions decreased by 4%, PM10 emissions were about 13% below the level of 1990, and PM2.5 emissions decreased by about 22%. The significant reduction of PM2.5 emission between 2010 and 2011 is strongly influenced by the mild winter (heating degree days declined by 12%).Apart from industry and road transport, private households and the agricultural sector are considerable contributors to emissions of PM. The explanations for these trends are given in the following chapters.

Table 30: National total emissions and emission trends for particulate matter (PM) 1990–2011.

Year	**Emissions [Mg]**		
	TSP	**PM10**	**PM2.5**
1990	62 527.92	39 751.26	24 135.15
:	NR	NR	NR
1995	63 164.23	39 179.54	23 387.81
:	NR	NR	NR
2000	63 311.73	38 603.66	22 535.89
2001	63 104.02	38 632.44	22 780.64
2002	62 119.02	37 594.63	22 022.77
2003	62 464.51	37 816.66	22 196.81
2004	63 178.34	37 951.94	21 968.69
2005	63 383.41	38 151.01	22 273.24
2006	61 475.79	36 452.41	20 960.96
2007	60 845.06	35 733.85	20 311.79
2008	61 915.38	36 176.11	20 197.54
2009	59 435.34	34 535.47	19 170.50
2010	60 197.25	35 195.61	19 764.12
2011	59 849.82	34 533.12	18 893.36
Trend 1990–2011	**-4%**	**-13%**	**-22%**

PM10 emissions and emission trends in Austria

PM10 is the fraction of suspended particulate matter in the air with an aerodynamic diameter (d_{ae}) of less than or equal to a 10 µm, which are collected with 50% efficiency by a PM10 sampling device. These particles are small enough to be breathable and could be deposited in lungs, which may cause deteriorated lung functions.

National total PM10 emissions amounted to 40 Gg in 1990 and have decreased steadily so that by the year 2011 emissions were reduced by 13% (to 35 Gg) – see Table 31.

As shown in Table 31, the main sources for PM10 emissions in Austria are combustion processes in the NFR Category 1 A *Fuel Combustion Activities* (59% in national total emissions in 2011) as well as handling of bulk materials like mineral products and the activities in the field of civil engineering of Category 2 *Industrial Processes*.

PM2.5 emissions and emission trends in Austria

The size fraction PM2.5 refers to particles with an aerodynamic diameter (d_{ae}) of less than or equal to 2.5 µm that are collected by measuring devices with 50% collection efficiency. Exposure to considerable amounts of PM2.5 can cause respiratory and circulatory complaints especially for sensitive individuals. PM2.5 also causes reductions in visibility and solar radiation due to enhanced scattering of light. Furthermore, aerosol precursors such as ammonia (the source of which is mainly agriculture) form PM2.5 as secondary particles through chemical reactions in the atmosphere.

National total PM2.5 emissions amounted to 24 Gg in 1990 and have decreased steadily so that by the year 2011 emissions were reduced by 22% (to 19 Gg) – see Table 32.

As shown Table 32, PM2.5 emissions in Austria mainly arose from combustion processes in the energy sector with a share of 83% in the total emissions in 2011. Besides the sources already mentioned in the context of TSP and PM10, PM2.5 emissions resulted on a big scale from power plants with flue gas cleaning systems, which filter larger particles. The sectors industrial processes and agriculture had a share of 8% and 7%, respectively, in national total emissions.

In general, the reduction of PM2.5 emission is due to the installation of flue gas collection and modern flue gas cleaning technologies in several branches.

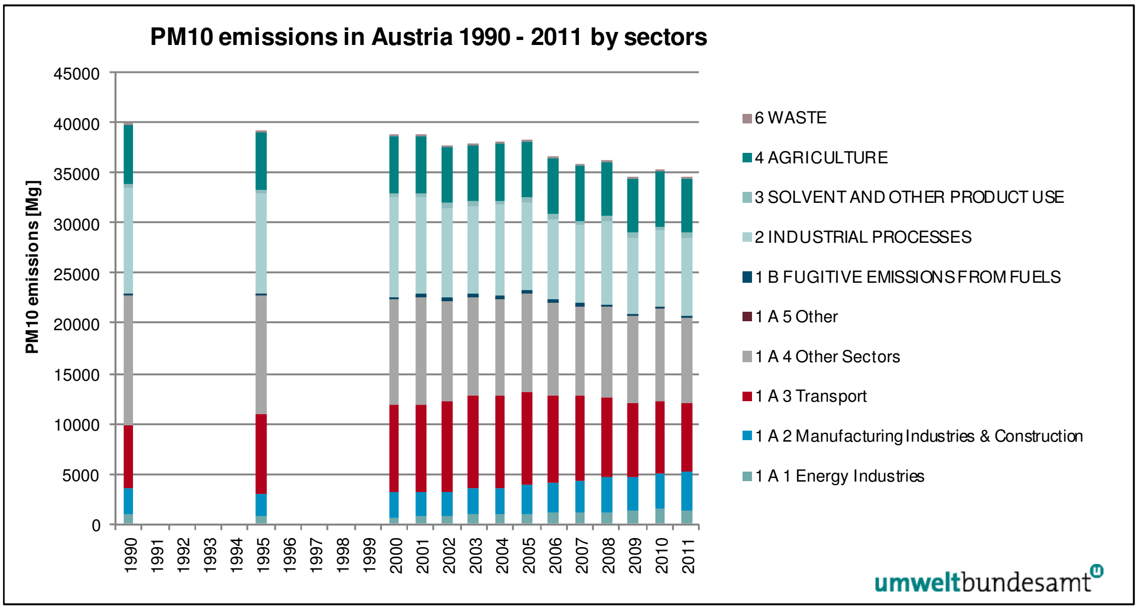
Total suspended particulate matter (TSP) emissions and emission trends in Austria

Total suspended particulate matter (TSP) refers to the entire range of ambient air matter that can be collected, from the sub-micron level up to 100 µm in aerodynamic diameter (d_{ae}). Particles with a d_{ae} larger than 100 µm will not remain in air for a significant length of time. TSP remains in the air for relatively short periods of time and are therefore generally not carried long distances. As a result TSP tend to be a local rather than a regional problem, occurring close to industrial sources, such as metal processing plants and mining operations, along roads because of the re-suspension, and close to stables and agricultural crop land.

National total TSP emissions amounted to 62.5 Gg in 1990 and remained quite stable over the period 1990 to 2011 and amounted to 59.8 Gg in 2011, see Table 33. TSP emissions in Austria derive from industrial processes, road transport, agriculture and small heating installations.

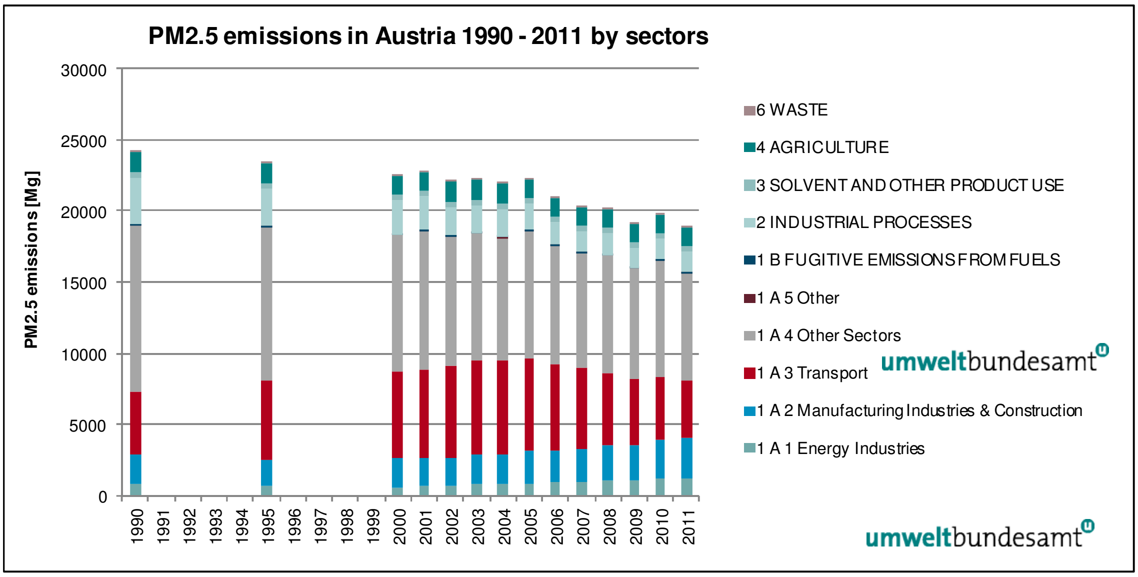
Table 31: PM10 emissions per NFR Category 1990 and 2011, their trend 1990–2011 and their share in total emissions.

NFR Category		**PM10 Emission in [Mg]**		**Trend**		**Share in National Total**	
		1990	**2011**	**1990–2011**	**2010-2011**	**1990**	**2011**
1	ENERGY	23 015.75	20 731.54	-10%	-4%	58%	60%
1 A	FUEL COMBUSTION ACTIVITIES	22 703.71	20 499.47	-10%	-4%	57%	59%
1 A 1	Energy Industries	976.72	1 407.42	44%	-6%	2%	4%
1 A 2	Manufacturing Industries and Construction	2 489.17	3 827.39	54%	8%	6%	11%
1 A 2 a	Iron and Steel	51.42	25.60	-50%	-6%	<1%	<1%
1 A 2 b	Non-ferrous Metals	11.28	7.49	-34%	-5%	<1%	<1%
1 A 2 c	Chemicals	292.13	395.09	35%	-3%	1%	1%
1 A 2 d	Pulp, Paper and Print	950.40	247.18	-74%	24%	2%	1%
1 A 2 e	Food Processing, Beverages and Tobacco	108.41	22.20	-80%	-17%	<1%	<1%
1 A 2 f	Other	1 075.54	3 129.82	191%	9%	3%	9%
1 A 3	Transport	6 375.76	6 879.54	8%	-5%	16%	20%
1 A 3 a	Civil Aviation	35.06	114.39	226%	12%	<1%	<1%
1 A 3 b	Road Transportation	5 287.57	6 051.33	14%	-6%	13%	18%
1 A 3 c	Railways	937.52	609.20	-35%	-1%	2%	2%
1 A 3 d	Navigation	113.79	101.43	-11%	10%	<1%	<1%
1 A 3 e	Pipeline compressors	1.82	3.19	75%	23%	<1%	<1%
1 A 4	Other Sectors	12 845.80	8 368.27	-35%	-8%	32%	24%
1 A 4 a	Commercial/Institutional	745.34	328.11	-56%	-7%	2%	1%
1 A 4 b	Residential	9 457.26	6 295.20	-33%	-10%	24%	18%
1 A 4 c	Agriculture/Forestry/Fisheries	2 643.20	1 744.96	-34%	-3%	7%	5%
1 A 5	Other	16.25	16.86	4%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	312.05	232.07	-26%	2%	1%	1%
2	INDUSTRIAL PROCESSES	10 450.05	7 795.83	-25%	3%	26%	23%
2 A	MINERAL PRODUCTS	4 941.19	6 389.78	29%	3%	12%	19%
2 A 1	Cement Production	156.37	49.79	-68%	2%	<1%	<1%
2 A 2	Lime Production	56.61	89.48	58%	6%	<1%	<1%
2 A 3	Limestone and Dolomite Use	NA	NA	NA	NA	NA	NA
2 A 4	Soda Ash Production and use	NA	NA	NA	NA	NA	NA
2 A 5	Asphalt Roofing	NA	NA	NA	NA	NA	NA
2 A 6	Road Paving with Asphalt	NA	NA	NA	NA	NA	NA
2 A 7	Other including Non Fuel Mining & Constr.	4 728.21	6 250.52	32%	3%	12%	18%
2 B	CHEMICAL INDUSTRY	565.22	270.90	-52%	1%	1%	1%
2 C	METAL PRODUCTION	4 575.34	684.84	-85%	9%	12%	2%
2 D	OTHER PRODUCTION	368.29	450.31	22%	<1%	1%	1%
3	SOLVENT AND OTHER PRODUCT USE	406.93	446.31	10%	<1%	1%	1%
4	AGRICULTURE	5 808.70	5 451.44	-6%	<1%	15%	16%
4 B	MANURE MANAGEMENT	IE	IE	IE	IE	IE	IE
4 D	AGRICULTURAL SOILS	5 126.36	4 895.50	-5%	<1%	13%	14%
4 F	FIELD BURNING OF AGRICUL. RESIDUES	137.94	81.19	-41%	-15%	<1%	<1%
4 G	Agriculture OTHER	544.40	474.75	-13%	-2%	1%	1%
6	WASTE	69.84	108.00	55%	15%	<1%	<1%
	Total without sinks	**39 751.26**	**34 533.12**	**-13%**	**-2%**		



Note: Interpolation for 1990 – 1995 and 1995 - 2000

Figure 14: PM10 emissions in Austria 1990 - 2011 by sectors in absolute terms

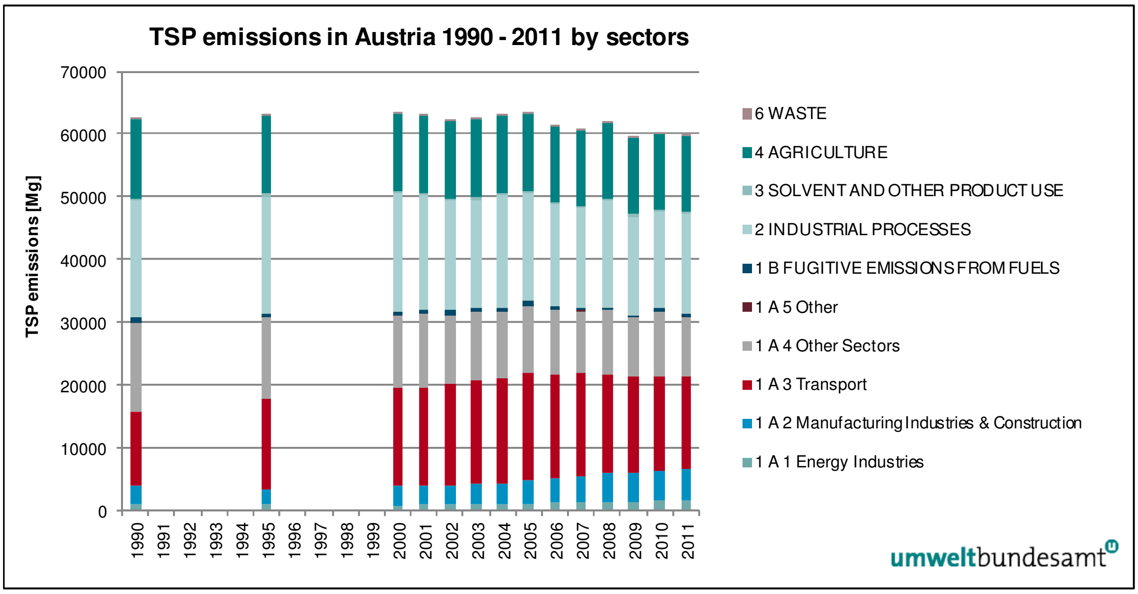


Note: Interpolation for 1990 – 1995 and 1995 - 2000

Figure 15: PM2.5 emissions in Austria 1990 - 2011 by sectors in absolute terms

Table 32: PM2.5 emissions per NFR Category 1990 and 2011, their trend 1990–2011 and their share in total emissions.

NFR Category		**PM2.5 Emission in [Mg]**		**Trend**		**Share in National Total**	
		1990	**2011**	**1990–2011**	**2010–2011**	**1990**	**2011**
1	ENERGY	19 069.50	15 707.36	-18%	-5%	79%	83%
1 A	FUEL COMBUSTION ACTIVITIES	18 972.25	15 634.10	-18%	-6%	79%	83%
1 A 1	Energy Industries	833.03	1 189.01	43%	-6%	3%	6%
1 A 2	Manufacturing Industries and Construction	2 062.77	2 831.95	37%	9%	9%	15%
1 A 2 a	Iron and Steel	42.85	21.33	-50%	-6%	<1%	<1%
1 A 2 b	Non-ferrous Metals	9.40	6.25	-34%	-5%	<1%	<1%
1 A 2 c	Chemicals	243.44	329.24	35%	-3%	1%	2%
1 A 2 d	Pulp, Paper and Print	781.44	203.24	-74%	24%	3%	1%
1 A 2 e	Food Processing, Beverages and Tobacco	90.34	18.50	-80%	-17%	<1%	<1%
1 A 2 f	Other	895.30	2 253.39	152%	10%	4%	12%
1 A 3	Transport	4 415.22	4 069.53	-8%	-9%	18%	22%
1 A 3 a	Civil Aviation	35.06	114.39	226%	12%	<1%	1%
1 A 3 b	Road Transportation	3 690.28	3 604.81	-2%	-10%	15%	19%
1 A 3 c	Railways	574.57	246.25	-57%	-3%	2%	1%
1 A 3 d	Navigation	113.79	101.43	-11%	10%	<1%	1%
1 A 3 e	Pipeline compressors	1.52	2.66	75%	23%	<1%	<1%
1 A 4	Other Sectors	11 645.42	7 527.18	-35%	-8%	48%	40%
1 A 4 a	Commercial/Institutional	675.66	310.09	-54%	-7%	3%	2%
1 A 4 b	Residential	8 506.17	5 684.40	-33%	-10%	35%	30%
1 A 4 c	Agriculture/Forestry/Fisheries	2 463.60	1 532.70	-38%	-3%	10%	8%
1 A 5	Other	15.80	16.43	4%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	97.25	73.26	-25%	2%	<1%	<1%
2	INDUSTRIAL PROCESSES	3 239.85	1 429.79	-56%	4%	13%	8%
2 A	MINERAL PRODUCTS	710.83	796.12	12%	3%	3%	4%
2 A 1	Cement Production	139.00	44.25	-68%	2%	1%	<1%
2 A 2	Lime Production	40.88	64.62	58%	6%	<1%	<1%
2 A 3	Limestone and Dolomite Use	NA	NA	NA	NA	NA	NA
2 A 4	Soda Ash Production and use	NA	NA	NA	NA	NA	NA
2 A 5	Asphalt Roofing	NA	NA	NA	NA	NA	NA
2 A 6	Road Paving with Asphalt	NA	NA	NA	NA	NA	NA
2 A 7	Other including Non Fuel Mining & Constr.	530.95	687.24	29%	3%	2%	4%
2 B	CHEMICAL INDUSTRY	301.97	142.77	-53%	1%	1%	1%
2 C	METAL PRODUCTION	2 079.67	310.83	-85%	9%	9%	2%
2 D	OTHER PRODUCTION	147.37	180.06	22%	<1%	1%	1%
3	SOLVENT AND OTHER PRODUCT USE	406.93	446.31	10%	<1%	2%	2%
4	AGRICULTURE	1 395.89	1 275.76	-9%	-1%	6%	7%
4 B	MANURE MANAGEMENT	IE	IE	IE	IE	IE	IE
4 D	AGRICULTURAL SOILS	1 140.71	1 090.55	-4%	<1%	5%	6%
4 F	FIELD BURNING OF AGRICULT. RES.	134.20	79.71	-41%	-15%	1%	<1%
4 G	Agriculture OTHER	120.98	105.50	-13%	-2%	1%	1%
6	WASTE	22.98	34.14	49%	15%	<1%	<1%
	Total without sinks	**24 135.15**	**18 893.36**	**-22%**	**-4%**		



Note: Interpolation for 1990 – 1995 and 1995 - 2000

Figure 16: TSP emissions in Austria 1990 - 2011 by sectors in absolute terms

Table 33: TSP emissions per NFR Category 1990 and 2011, their trend 1990 – 2011 and their share in total emissions.

NFR Category		TSP Emission in [Mg]		Trend		Share in National Total	
		1990	2011	1990-2011	2010-2011	1990	2011
1	ENERGY	30 698.80	31 309.72	2%	-3%	49%	52%
1 A	FUEL COMBUSTION ACTIVITIES	30 036.19	30 819.10	3%	-3%	48%	51%
1 A 1	Energy Industries	1 030.72	1 537.52	49%	-6%	2%	3%
1 A 2	Manufacturing Industries and Construction	2 880.87	5 042.11	75%	7%	5%	8%
1 A 2 a	Iron and Steel	57.13	28.45	-50%	-6%	<1%	<1%
1 A 2 b	Non-ferrous Metals	12.53	8.33	-34%	-5%	<1%	<1%
1 A 2 c	Chemicals	324.59	438.99	35%	-3%	1%	1%
1 A 2 d	Pulp, Paper and Print	1 056.00	274.64	-74%	24%	2%	<1%
1 A 2 e	Food Processing, Beverages and Tobacco	120.45	24.67	-80%	-17%	<1%	<1%
1 A 2 f	Other	1 310.17	4 267.04	226%	7%	2%	7%
1 A 3	Transport	11 976.64	14 906.97	24%	-1%	19%	25%
1 A 3 a	Civil Aviation	35.06	114.39	226%	12%	<1%	<1%
1 A 3 b	Road Transportation	9 851.24	13 041.41	32%	-2%	16%	22%
1 A 3 c	Railways	1 974.52	1 646.20	-17%	<1%	3%	3%
1 A 3 d	Navigation	113.79	101.43	-11%	10%	<1%	<1%
1 A 3 e	Pipeline compressors	2.03	3.55	75%	23%	<1%	<1%
1 A 4	Other Sectors	14 130.96	9 314.94	-34%	-8%	23%	16%
1 A 4 a	Commercial/Institutional	809.72	346.13	-57%	-8%	1%	1%
1 A 4 b	Residential	10 408.36	6 906.01	-34%	-10%	17%	12%
1 A 4 c	Agriculture/Forestry/Fisheries	2 912.88	2 062.80	-29%	-2%	5%	3%
1 A 5	Other	17.00	17.57	3%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	662.61	490.62	-26%	2%	1%	1%
2	INDUSTRIAL PROCESSES	18 538.68	15 853.83	-14%	3%	30%	26%
2 A	MINERAL PRODUCTS	10 210.81	13 300.44	30%	3%	16%	22%
2 A 1	Cement Production	173.75	55.32	-68%	2%	<1%	<1%
2 A 2	Lime Production	62.90	99.42	58%	6%	<1%	<1%
2 A 3	Limestone and Dolomite Use	NA	NA	NA	NA	NA	NA
2 A 4	Soda Ash Production and use	NA	NA	NA	NA	NA	NA
2 A 5	Asphalt Roofing	NA	NA	NA	NA	NA	NA
2 A 6	Road Paving with Asphalt	NA	NA	NA	NA	NA	NA
2 A 7	Other incl. Non Fuel Mining &Construction	9 974.16	13 145.70	32%	3%	16%	22%
2 B	CHEMICAL INDUSTRY	957.60	462.19	-52%	1%	2%	1%
2 C	METAL PRODUCTION	6 450.11	965.78	-85%	9%	10%	2%
2 D	OTHER PRODUCTION	920.16	1 125.43	22%	<1%	1%	2%
3	SOLVENT AND OTHER PRODUCT USE	406.93	446.31	10%	<1%	1%	1%
4	AGRICULTURE	12 737.85	12 011.95	-6%	<1%	20%	20%
4 B	MANURE MANAGEMENT	IE	IE	IE	IE	IE	IE
4 D	AGRICULTURAL SOILS	11 390.12	10 875.77	-5%	<1%	18%	18%
4 F	FIELD BURNING OF AGRICULTURAL RES.	137.94	81.19	-41%	-15%	<1%	<1%
4 G	Agriculture OTHER	1 209.79	1 054.99	-13%	-2%	2%	2%
6	WASTE	145.67	228.01	57%	15%	<1%	<1%
	Total without sinks	**62 527.92**	**59 849.82**	**-4%**	**-1%**		

2.2.1 Particle Matter (PM) Emission Trends by Source category

PM Emission Trends in Category 1 A Fuel Combustion Activities

The Sector *Energy* is an important source for PM emissions in Austria. All major sub categories are key sources of the Austrian Inventory regarding all three reported fractions of PM. As shown in Table 31 to Table 33 for the period from 1990 to 2011:

- TSP emissions increased by about 3% to 30.8 Gg, which is a share of 51% in total TSP emissions in 2011.
- PM10 emissions decreased by about 10% to 20.5 Gg, which is a share of 59% in total PM10 emissions in 2011.
- PM2.5 emissions decreased by about 18% to 15.6 Gg, which is a share of 83% in total PM2.5 emissions in 2011.

In 2011 within this category NFR *1 A 3 Transport* and *1 A 4 Other Sectors* have together the highest contribution to TSP, PM10 and PM2.5 emissions: 40% of the national TSP emissions, 44% of the national PM10 emissions and 61% of the national PM2.5.

The emissions in the following categories are largely due to fuel combustion activities:

- NFR 1 A 4 *Other Sectors* includes fuel combustion in commercial and institutional buildings, households and in the area of agriculture and fishery and has a contribution of 16% TSP, 24% PM10 and 40% PM2.5 emission of the respective national totals. PM emissions arose from:
  - *NFR 1 A 4 b Households* (residential plants); small combustion plants and household ovens and stoves are large sources of TSP, PM10 and PM2.5,
  - *NFR 1 A 4 c* Agriculture and Forestry; Off Road Vehicles and Other Machinery are important sources of PM2.5.
- NFR 1 A 3 *Transport* which includes transportation activities, mechanical abrasion from road surfaces, and re-suspended dust from roads and has a contribution of 25% TSP, 20% PM10 and 22% PM2.5 emissions of the respective national totals. PM emissions arose from:
  - *Automobile Road Abrasion,*
  - Road transport activities with *Passenger cars* and *Heavy duty vehicles* represent the majority of PM sources.
- NFR 1 A 2 *Manufacturing Industries and Construction* has a contribution of 8% TSP, 11% of PM10 and 15% of PM2.5 emissions of the respective national totals.
- NFR 1 A 1 *Energy Industrie*s has a contribution of 3% TSP, 4% of PM10 and 6% of PM2.5 emissions of the respective national totals.

As presented in Table 32, the emissions of PM2.5 from 1 A *Fuel Combustion Activities* decreased by 18% and PM10 decreased by 10%. The achievements made by several appropriate measures in this category are the following:

- *Energy Industry* and *Manufacturing Industries and Construction:*
  - application of abatement techniques such as flue gas collection and flue gas cleaning systems (already in the 1980),
  - installation of energy- and resource-saving production processes (already in the 1980),
  - substitution from high-emission fuels to low-emission (low-ash) fuels (already in the 1980),
  - raising awareness for environmental production.

The measures are more than counterbalanced in the last decade by the enourmous increase in energy consumption. Another reason of increasing PM emissions is the application of CO_2-neutral fuels such as biomass (wood, pellets etc.) in district-heating plants. These fuels are even with modern technology, high-emission fuels regarding PM.

- *1 A 4 Other Sector:*
  - substitution of old installations with modern technology,
  - installation of energy-saving combustion plants,
  - connection to the district-heating networks or other public energy- and heating networks,
  - substitution from high-emission fuels to low-emission (low-ash) fuels,
  - raising awareness for energy saving and environmental task.
  - This downward trend counteracted the application of CO_2-neutral fuels such as biomass (wood, pellets etc.) in district-heating plants.
- *1 A 3 Transport:*
  - All the above mentioned measures but also all technical improvements of the engines of the vehicles are almost completely compensated by enormously increasing PM 2.5 and PM10 emissions of this category due to increased transport activities of both individual transport (passanger cars) and road/highway transport with heavy duty vehicles. These activities induce of course increasing PM emissions from automobile tyre and brake wear as well as mechanical abrasion from road surfaces, and re-suspended dust from roads.

PM Emission Trends in Category 1 B Fugitive Emissions

Fugitive TSP, PM10 and PM2.5 emissions originate from storage of solid fuels (coke oven coke, bituminous coal and anthracite, lignite and brown coal). Emissions from this category contribute about 1% to national totals.

PM Emission Trend in NFR Category 2 Industrial Processes

The Sector *Industrial Processes* had, in 2011, a share of 23% in national total PM10 emissions, 8% in national total PM2.5 emissions and 26% in national total TSP emissions.

- *NFR 2 A Mineral products*

  Whithin the NFR category 2, the subcategory NFR 2 A is responsible for about 22% of the national total TSP and about 19% of national PM10 emission, respectively. The handling of bulk materials like mineral products and the activities in the field of civil engineering represent the majority of PM sources.

  The significant increase in PM emission subcategory NFR 2 A *Mineral products* is a result of increased activities due to manifold construction activities, whereas from 2008 to 2010 a decrease because of the economic crisis can be noted. In 2011 the recovery of the economy can be observed due to increasing PM emissions in this subcategory.
- *NFR 2 B Chemical Industry*

  Whithin the NFR category 2, the subcategory NFR 2 B is only responsible for about 1 % of the national total PM emissions.

  Also, in NFR 2 B considerable efforts were made in reducing PM emissions due to protective enclosure process lines and bulk materials.
- *NFR 2 C Metal Production*

  The activities in subcategory NFR 2 C *Metal Production* (mainly Iron and Steel production) are responsible for about 2% of the national total PM emissions.

In the NFR subcategory 2 C, a decreasing trend of about 85% of all PM fractions can be noted for the period 1990 to 2011 because considerable efforts were made by introducing low-PM technologies, abatement techniques, flue gas collection and flue gas cleaning systems etc.

- *NFR 2 D Other Production*

  The activities in the subcategory NFR 2 D, which comprise wood processing as well as food and drink production, are responsible for about 2% of TSP and for about 1% of of national total PM10 and PM2.5 emissions, respectively.

  In the NFR subcategory 2 D, an increasing trend of about 22% of all PM fractions can be noted for the period 1990 to 2011 because of increasing production and handling activities.

PM Emission trend in NFR Category 3 Solvents and Other Product Use

In the NFR Category 3 *Solvent and Other Product Use*, which includes fireworks and smoking of tobacco, an increasing emission trend of 10% in national total TSP, PM10 and PM2.5 emission, respectively, can be noted for the period 1990 to 2011. This category is a minor PM source.

PM Emission trend in NFR Category 4 Agriculture

The NFR category 4 *Agriculture* has a contribution to the national total PM10, PM2.5 and TSP emissions of 16%, 7% and 20%, in 2011. Within this category NFR subcategory 4 D *Agricultural Soils*, which consider tillage operations and harvesting activities, is the main source of PM emissions.

The decrease in agricultural production (soil cultivation, harvesting etc.) is responsible for the decrease of about 9% of the national total PM2.5. National total TSP and PM10 emissions decreased by 6% over the period 1990 to 2011.

A comparatively small amount of the agricultural PM emissions results from animal husbandry (NFR 4 G), where a decreasing trend of 13% can be noted.

PM Emission trend in NFR Category 6 Waste

Within the NFR category 6 *Waste,* the subcategory NFR 6 A *Solid Waste Disposal on Land* is the main source (only negligible amounts of PM emissions are caused by NFR 6 C *Waste Incineration*). TSP, PM10 and PM2.5 emissions in this subcategory increased by about 59% each in the period 1990 to 2011 due to underlying activity data.

2.3 Emission Trends for Heavy Metals

In general emissions of heavy metals decreased remarkably from 1985 to 2011. The significant reduction due to the economical crisis in 2009 is counterbalanced by the rebound of the economy in 2010 and 2011. Emission trends for heavy metals from 1985 to 2011 are presented in Table 34. Emissions for all three priority heavy metals (Cd, Pb, Hg) are well below their 1985 level, which is the obligation for Austria as a Party to the Heavy Metals Protocol.

Table 34: National total emissions and emission trends for heavy metals 1985–2011.

Year	**Emissions [Mg]**		
	Cd	**Hg**	**Pb**
1985	3.101	3.745	325.981
1986	2.693	3.317	312.107
1987	2.207	2.843	305.990
1988	1.932	2.446	275.530
1989	1.739	2.235	242.024
1990	1.584	2.144	218.959
1991	1.533	2.040	179.883
1992	1.253	1.643	124.860
1993	1.168	1.394	87.417
1994	1.068	1.181	59.901
1995	0.978	1.202	16.082
1996	1.000	1.160	15.524
1997	0.970	1.133	14.463
1998	0.900	0.949	12.980
1999	0.948	0.934	12.427
2000	0.923	0.890	11.909
2001	0.949	0.954	12.030
2002	0.934	0.916	12.164
2003	0.972	0.957	12.464
2004	0.976	0.930	12.809
2005	1.067	0.996	13.629
2006	1.057	1.007	13.690
2007	1.089	1.009	14.386
2008	1.117	1.026	14.719
2009	1.052	0.897	12.605
2010	1.185	1.009	15.351
2011	1.161	1.005	15.419
Trend 1985–2011	**-63%**	**-73%**	**-95%**
Trend 1990–2011	**-27%**	**-53%**	**-93%**

2.3.1 Cadmium (Cd) Emissions

Cadmium (Cd) has been ubiquitously distributed in the natural environment for millions of years. It occurs in the earth's crust with a content estimated to be between 0.08 and 0.5 ppm. Unlike some other heavy metals, such as lead or mercury, which have been used since ancient times, Cd has been refined and utilized only since 100 years, but it was already discovered in 1817. The production and consumption of Cd has risen distinctly only since the 1940's. The primary uses are electroplated cadmium coatings, nickel-cadmium storage batteries, pigments, and stabilizers for plastics. Publicity about the toxicity of cadmium has affected the consumption significantly.

For human beings Cd does not have a biological function unlike many other elements. The smoking (of tobacco) stands for an important exposure to Cd: smokers generally have about twice as high cadmium concentrations in the renal cortex compared to non-smokers. For the non-smoking population food is an important source of exposure because Cd is accumulated in the human and animal bodies due to its long half-life. Cd compounds and complexes are classified as an unambiguous carcinogenic working material.

Cadmium emissions and emission trends in Austria

National total Cd emissions amounted to 3.1 Mg in 1985, and amounted to 1.58 Mg in 1990; since then emissions have decreased steadily and by the year 2011 emissions were reduced by 63% (1.16 Mg) in the period 1985–2011; however the reduction of national total Cd emissions were reduced only by 27% in the period 1990–2011 (see Table 34).

The overall reduction from 1985 to 2011 is mainly due to decreasing emissions from the industrial processes and energy sector because of a decrease in the use of heavy fuel oil and improved or newly installed flue gas abatement techniques. The significant emission reduction in the Sector *Solvent and Other Product Use* results from the ban of Cd in paint.

Cd emissions are increasing again in the last few years, which is due to the growing activities in the industrial processes sector and energy sector.

Cd Emission Trends in NFR Category 1 A Fuel Combustion Activities

NFR category 1 A is an important source for Cd emissions because of the combustion of a considerable amount of solid fuels (fossil and biogenic). In the period from 1990 to 2011 Cd emissions decreased by 13% to 0.93 Mg, which is a share of 80% in national total Cd emission in 2011 (see Table 35). The main sources for Cd emissions in NFR 1 A are:

	Contribution in Total Cd emission (2011)
● NFR 1 A 1 Energy Industries	26%
● NFR 1 A 2 Manufacturing Industries and Construction	21%
● NFR 1 A 3 Transport *of which Road Transport*	8% *8%*
● NFR 1 A 4 Other Sectors (Comercial, Institutional and Residential heating etc.)	25%

In all subcategories, except NFR 1 A 1 and NFR 1 A 3, Cd emissions have decreased steadily mainly due to an increase in efficiency, implementation and installation of flugas treatment system as well as by dust removal systems.

In NFR 1 A 1 the increasing Cd-emission in the last ten years were due to increasing use of wood and wooden litter in small combustion plants, the combustion of heavy fuel oil and residues from the petroleum processing in the refinery as well as the thermal utilisation of industrial residues and residential waste. The use of hard coal has increased in this period.

In NFR 1 A 3 transport sector an increase of Cd emission could be noted because of the enormous increasing activity of the transport sector in passenger and freight transport. Cd emissions arise from tire and brake abrasion.

Cd Emission Trends in NFR Category 2 Industrial Processes

As shown in Table 35 in the period from 1990 to 2011 the Cd emissions decreased by 50% to 0.23 Mg, which is a share of 20% to the total Cd emission. The sub sector NFR 2 C *Metal Production* covers activities reported under NFR 2 C 1 Iron and steel. However, emissions from this sub sector decreased significantly due to extensive abatement measures but also by production and product substitution. The significant reduction due to the economical crisis in 2009 is counterbalanced by the rebound of the economy in 2010 and 2011.

A small source for Cd emission of NFR Category 2 Industrial Processes was the sub sectors NFR 2 B Chemical Industry, which covers processes in inorganic chemical industries reported under NFR 2 B 5 Other. However, emissions from this sub sector decreased due to abatement measures but also by production and product substitution.

Cd Emission trend in NFR Category 3 Solvents and Other Product Use

NFR Cateogy 3 is because of the ban of Cd in paints a minor source of Cd emission. The share of this category in national total Cd emission is less than 0.1%.

Cd Emission trend in NFR Category 4 Agriculture

Field Burning of Agricultural Waste (NFR 4 F) is the only emission source for Cd emissions of the Sector Agriculture. In 2011, emissions only contribute about 0.1% (0.001 Mg) to national total emissions. Emissions vary on a very small scale with the area of stubble fields burnt each year.

Cd Emission trend in NFR Category 6 Waste

NFR Category *Waste* comprises Cd emissions from NFR subcategory 6 A *Solid Waste Disposal* on Land and NFR 6 C *Waste Incineration*. The waste sector represents with a share of about 0.1% in national total Cd emission only a minor source.

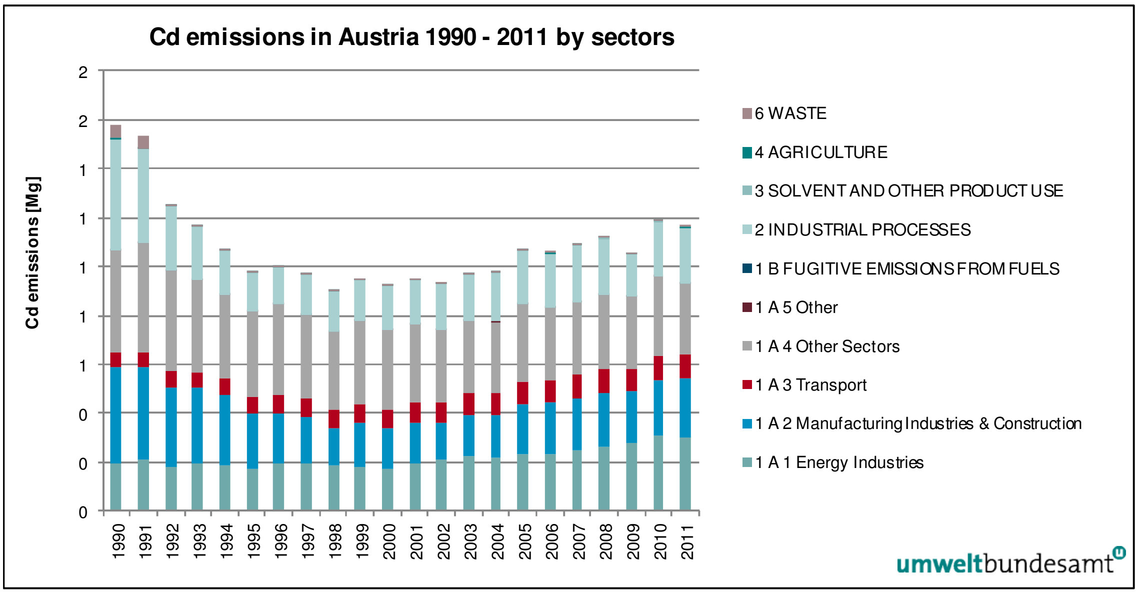


Figure 17: Cd emissions in Austria 1990 - 2011 by sectors in absolute terms

Table 35: Cd emissions per NFR Category 1990 and 2011, their trend 1990–2011 and their share in total emissions.

NFR Category		**Cd Emission in [Mg]**		**Trend**		**Share in National Total**	
		1990	**2011**	**1990–2011**	**2010-2011**	**1990**	**2011**
1	ENERGY	1.066	0.929	-13%	-3%	67%	80%
1 A	FUEL COMBUSTION ACTIVITIES	1.066	0.929	-13%	-3%	67%	80%
1 A 1	Energy Industries	0.194	0.299	54%	-3%	12%	26%
1 A 1 a	Public Electricity and Heat Production	0.104	0.153	48%	-6%	7%	13%
1 A 1 b	Petroleum refining	0.091	0.145	60%	1%	6%	13%
1 A 1 c	Manufacture of Solid fuels & Other Energy Ind.	NA	NA	NA	NA	NA	NA
1 A 2	Manufacturing Industries and Construction	0.391	0.243	-38%	5%	25%	21%
1 A 2 a	Iron and Steel	0.006	0.004	-42%	2%	<1%	<1%
1 A 2 b	Non-ferrous Metals	0.084	0.016	-81%	<1%	5%	1%
1 A 2 c	Chemicals	0.028	0.017	-40%	-1%	2%	1%
1 A 2 d	Pulp, Paper and Print	0.144	0.100	-31%	-1%	9%	9%
1 A 2 e	Food Processing, Beverages and Tobacco	0.002	0.000	-88%	-17%	<1%	<1%
1 A 2 f	Other	0.127	0.106	-16%	13%	8%	9%
1 A 3	Transport	0.061	0.098	62%	2%	4%	8%
1 A 3 a	Civil Aviation	0.000	0.000	217%	13%	<1%	<1%
1 A 3 b	Road Transportation	0.060	0.098	63%	2%	4%	8%
1 A 3 c	Railways	0.000	0.000	-85%	<1%	<1%	<1%
1 A 3 d	Navigation	0.000	0.000	4%	-10%	<1%	<1%
1 A 3 e	Pipeline compressors	NA	NA	NA	NA	NA	NA
1 A 4	Other Sectors	0.419	0.289	-31%	-11%	26%	25%
1 A 4 a	Commercial/Institutional	0.075	0.022	-70%	-14%	5%	2%
1 A 4 b	Residential	0.312	0.211	-32%	-10%	20%	18%
1 A 4 c	Agriculture/Forestry/Fisheries	0.032	0.056	72%	-11%	2%	5%
1 A 5	Other	0.000	0.000	33%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	NA	NA	NA	NA	NA	NA
2	INDUSTRIAL PROCESSES	0.457	0.230	-50%	3%	29%	20%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	0.001	0.001	-29%	1%	<1%	<1%
2 C	METAL PRODUCTION	0.456	0.230	-50%	3%	29%	20%
2 D	OTHER PRODUCTION	NA	NA	NA	NA	NA	NA
3	SOLVENT AND OTHER PRODUCT USE	0.000	0.000	<1%	<1%	<1%	<1%
4	AGRICULTURE	0.002	0.001	-39%	-13%	<1%	<1%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRICULTURAL RES.	0.002	0.001	-39%	-13%	<1%	<1%
4 G	AGRICULTURE OTHER	NA	NA	NA	NA	NA	NA
6	WASTE	0.059	0.001	-99%	-6%	4%	<1%
6 A	SOLID WASTE DISPOSAL ON LAND	0.001	0.001	-62%	-7%	<1%	<1%
6 B	WASTEWATER HANDLING	NA	NA	NA	NA	NA	NA
6 C	WASTE INCINERATION	0.058	0.000	-100%	<1%	4%	<1%
6 D	OTHER WASTE	NA	NA	NA	NA	NA	NA
	Total without sinks	**1.584**	**1.161**	**-27%**	**-2%**		

2.3.2 Mercury (Hg) Emissions

Mercury (Hg) has been ubiquitously distributed in the natural environment for millions of years. It occurs in the earth's crust with a content estimated to be about $4{\cdot}10^{-5}$%. Because of its special properties, mercury has had a number of uses for a long time: the conventional application is the thermometer, barometer, and hydrometer; other important areas of use are the lighting industry and for electrical components. Mercury forms alloys with a large number of metals, these alloys also have a wide range of applications.

Mercury emissions and emission trends in Austria

In 1985 national total Hg emissions amounted to 3.7 Mg and amounted to 2.1 Mg in 1990; emissions have decreased steadily and by the year 2011 emissions were reduced by 73%; however the reduction of national total Hg emissions were reduced by 53% in the period 1990–2011 (see Table 34).

The overall reduction of about 73% for the period 1985 to 2011 was due to decreasing emissions from the industrial processes sector and residential heating due to a decrease in the use of heavy fuel oil and wood as fuel and also due to improved emission abatement techniques in industry. Several bans in different industrial sub-sectors as well in the agriculture sector lead to the sharp fall of total Hg emission in Austria.

Hg Emission Trends in NFR Category 1 A Fuel Combustion Activities

Hg emissions mainly arise from NFR category 1 A by combustion processes with a share of 66% of the total emissions in 2011 (see Table 36). In 2011, Hg emissions amounted to 0.7 Mg. These emissions are composed of emissions from combustion of coal, heavy fuel oil and waste in manufacturing industries and construction, the combustion of wood, wood waste and coal in residential plants and combustion of coal and heavy fuel oil in public electricity and heat production. Overall Hg emissions could be reduced significantly by different abatement techniques such as filter installation and wet flue gas treatment in industry and due to decreasing coal consumption in the residential sector. The main sources for Hg emissions in NFR 1 A are:

	Contribution in Total Hg emission (2011)
● NFR 1 A 1 Energy Industries	21%
● NFR 1 A 2 Manufacturing Industries and Construction	28%
● NFR 1 A 3 Transport	<1%
● NFR 1 A 4 Other Sectors (Comercial, Institutional and Residential heating etc.)	16%

Hg Emission Trends in NFR Category 2 Industrial Processes

Process related emissions in the NFR category 2 *Industrial Processes* (especially metal industries) account for about 32% of national total Hg emissions in 2011. As shown in Table 36, in the period from 1990 to 2011, the Hg emissions decreased by 38% to 0.33 Mg.

The sub category 2 C *Metal Production* covers activities reported under NFR 2 C 1 *Iron and steel*. However, emissions from this sub-sector are the main source and increased by about 26 % due to implemented extensive abatement measures which were compensated by increased activities. The significant reduction due to the economical crisis in 2009 is counterbalanced by the rebound of the economy in 2010 and 2011 and nearly reaches the level of production of 2008.

A small source for Hg emissions of NFR Category 2 *Industrial Processes* was the sub sector NFR 2 B *Chemical Industry,* which covers processes in inorganic chemical industries reported under NFR 2 B 5 *Other*. However, emissions from this sub sector decreased significantly due to abatement measures but also by production process substitution and product substitution. Furthermore, in 1999, the process of chlorine production was changed from mercury cell to membrane cell.

Hg Emission Trend in NFR Category 3 Solvent Use and Other Product Use

No Hg emissions occur from NFR 3 Solvent Use and Other Product Use.

Hg Emission trend in NFR Category 4 Agriculture

Field Burning of Agricultural Waste (NFR 4 F) is the only emission source for Hg emissions of the Sector *Agriculture*. In 2011, emissions only contributed less than 0.1% (0.2 kg) to national total emissions. Emissions vary on a very small scale with the area of stubble fields burnt each year.

Hg Emission trend in NFR Category 6 Waste

NFR Category 6 *Waste* was with a share of about 2% in national total Hg emission a small source. The main category was sub category 6 C *Waste Incineration* which covers activities reported under NFR 6 C d *Cremation*. The overall emission reduction of NFR 6 *Waste* was about 63%.

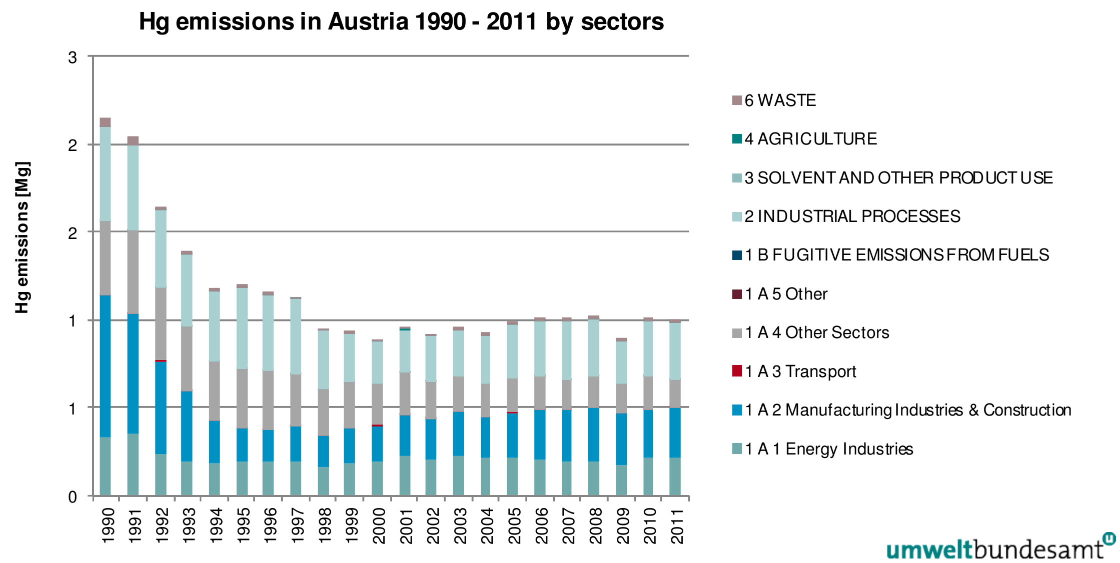


Figure 18: Hg emissions in Austria 1990 - 2011 by sectors in absolute terms

Table 36: Hg emissions per NFR Category 1990 and 2011, their trend 1990–2011 and their share in total emissions.

NFR Category		**Hg Emission in [Mg]**		**Trend**		**Share in National Total**	
		1990	**2011**	**1990–2011**	**2010-2011**	**1990**	**2011**
1	ENERGY	1.562	0.660	-58%	-2%	73%	66%
1 A	FUEL COMBUSTION ACTIVITIES	1.562	0.660	-58%	-2%	73%	66%
1 A 1	Energy Industries	0.334	0.214	-36%	2%	16%	21%
1 A 1 a	Public Electricity and Heat Production	0.327	0.204	-38%	2%	15%	20%
1 A 1 b	Petroleum refining	0.007	0.010	44%	-1%	<1%	1%
1 A 1 c	Manufacture of Solid fuels & Other Energy Ind.	NA	NA	NA	NA	NA	NA
1 A 2	Manufacturing Industries and Construction	0.799	0.279	-65%	1%	37%	28%
1 A 2 a	Iron and Steel	0.000	0.000	-19%	1%	<1%	<1%
1 A 2 b	Non-ferrous Metals	0.007	0.008	11%	<1%	<1%	1%
1 A 2 c	Chemicals	0.012	0.010	-12%	-2%	1%	1%
1 A 2 d	Pulp, Paper and Print	0.066	0.073	11%	1%	3%	7%
1 A 2 e	Food Processing, Beverages and Tobacco	0.001	0.000	-65%	-1%	<1%	<1%
1 A 2 f	Other	0.713	0.187	-74%	1%	33%	19%
1 A 3	Transport	0.002	0.002	1%	-4%	<1%	<1%
1 A 3 a	Civil Aviation	0.000	0.000	217%	13%	<1%	<1%
1 A 3 b	Road Transportation	0.001	0.002	55%	-4%	<1%	<1%
1 A 3 c	Railways	0.001	0.000	-92%	2%	<1%	<1%
1 A 3 d	Navigation	0.000	0.000	4%	-10%	<1%	<1%
1 A 3 e	Pipeline compressors	NA	NA	NA	NA	NA	NA
1 A 4	Other Sectors	0.427	0.165	-61%	-11%	20%	16%
1 A 4 a	Commercial/Institutional	0.027	0.008	-71%	-13%	1%	1%
1 A 4 b	Residential	0.387	0.142	-63%	-11%	18%	14%
1 A 4 c	Agriculture/Forestry/Fisheries	0.014	0.016	13%	-11%	1%	2%
1 A 5	Other	0.000	0.000	33%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	NA	NA	NA	NA	NA	NA
2	INDUSTRIAL PROCESSES	0.528	0.325	-38%	3%	25%	32%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	0.270	0.000	-100%	1%	13%	<1%
2 C	METAL PRODUCTION	0.257	0.325	26%	3%	12%	32%
2 D	OTHER PRODUCTION	NA	NA	NA	NA	NA	NA
3	SOLVENT AND OTHER PRODUCT USE	NA	NA	NA	NA	NA	NA
4	AGRICULTURE	0.000	0.000	-42%	-16%	<1%	<1%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRI. RESIDUES	0.000	0.000	-42%	-16%	<1%	<1%
4 G	Agriculture OTHER	NA	NA	NA	NA	NA	NA
6	WASTE	0.054	0.020	-63%	<1%	2%	2%
6 A	SOLID WASTE DISPOSAL ON LAND	0.000	0.000	-62%	-7%	<1%	<1%
6 B	WASTEWATER HANDLING	NA	NA	NA	NA	NA	NA
6 C	WASTE INCINERATION	0.054	0.020	-63%	<1%	2%	2%
6 D	OTHER WASTE	NA	NA	NA	NA	NA	NA
	Total without sinks	**2.144**	**1.005**	**-53%**	**<1%**		

2.3.3 Lead (Pb) Emissions

In the past, automotive sources were the major contributor of lead emissions to the atmosphere. Due to Austrian regulatory efforts to reduce the content of lead in gasoline the contribution of air emissions of lead from the transportation sector has drastically declined over the past two decades. Today, industrial processes, primarily metals processing, are the major sources of lead emissions. The highest air concentrations of lead are usually found in the vicinity of smelters and battery manufacturers. Exposure to lead occurs mainly through inhalation of air and ingestion of lead in food, water, soil, or dust. It accumulates in the blood, bones, and soft tissues and can adversely affect the kidneys, liver, nervous system, and other organs. Lead can also be deposited on the leaves of plants, which pose a hazard to grazing animals and humans through ingestion via food chain.

Lead emissions and emission trends in Austria

In 1985 national total Pb emissions amounted to 326 Mg and to 219 Mg in 1990; emissions have decreased steadily since 1990 and by the year 2011 emissions were reduced by 93% (15 Mg) mainly due to enforced laws. The overall reduction trend was 95% for the period 1985-2011. As it is shown in Table 37 today's Pb emissions mainly arise from the NFR 1 A *FUEL COMBUSTION ACTIVITIES:* with a share of about 76 % of the Austrian Pb emissions result from sector 1 A 3 Transport in 1990 and about 11% result from all other combustion processes. From 1990 to 1995 Pb emissions from this sub-sector decreased by 100% due to prohibition of the addition of lead to petrol.

In addition to emission reduction in the energy sector the sector industrial proesses reduced its emissions remarkably due to improved dust abatement technologies. The significant emission reduction in the sector solvent and other product use results from the ban of Pb in this production field or products.

Pb Emission Trends in NFR Category 1 A Fuel Combustion Activities

NFR category 1 A is an important source for Pb emissions because of the combustion of a considerable amount of solid fuels (fossil and biogenic). In the period from 1990 to 2011, Pb emissions decreased by 95% to 8.5 Mg, which is a share of 55% in national total Pb emission in 2011 (see Table 37). The main sources for Pb emissions in NFR 1 A are:

	Contribution in Total Pb emission (2011)
● NFR 1 A 1 Energy Industries	16%
● NFR 1 A 2 Manufacturing Industries and Construction	26%
● NFR 1 A 3 Transport	<1%
● NFR 1 A 4 Other Sectors (Comercial, Institutional and Residential heating etc.)	13%

In all subcategories, except NFR 1 A 1 and NFR 1 A 5, Pb emissions have decreased steadily mainly due to an increase in efficiency, implementation and installation of flue gas treatment system as well as due to dust removal systems. The enormous reduction was achieved by elimination of Pb in motor gasoline. In NFR 1 A 1 *Energy Industries* increasing Pb emissions could be noted in the last decade due to increasing activities.

Pb Emission Trends in NFR Category 2 Industrial Processes

As shown in Table 37 in the period from 1990 to 2011, the Pb emissions decreased by 79% to 6.9 Mg, which is a share of 44% to the total Pb emission. The sub sector NFR 2 C *Metal Production* covers activities reported under NFR 2 C 1 *Iron and steel*. However, emissions from this sub sector decreased significantly due to extensive abatement measures but also due to production process substitution and product substitution.

A small source for Pb emissions of NFR Category 2 *Industrial Processes* was the sub sector NFR 2 B *Chemical Industry,* which covers processes in inorganic chemical industries reported under NFR 2 B 5 *Other*. However, emissions from this sub sector decreased due to abatement measures but also due to production process substitution and product substitution. Furthermore, in 1999, the process of chlorine production was changed from mercury cell to membrane cell. The significant reduction due to the economical crisis in 2009 is counterbalanced by the rebound of the economy in 2010 and 2011.

Pb Emission Trend in NFR Category 3 Solvent Use and Other Product Use

NFR Cateogy 3 is a minor source of Pb emission. The share of this category in national total Pb emission is about 0.1% (0.02 Mg).

Pb Emission trend in NFR Category 4 Agriculture

Field Burning of Agricultural Waste (NFR 4 F) is the only emission source for Pb emissions of the Sector *Agriculture*. In 2011, emissions only contributed less than 0.1% (0.01 Mg) to national total emissions. Emissions vary on a very small scale with the area of stubble fields burnt each year.

Pb Emission trend in NFR Category 6 Waste

Pb emissions from NFR Category *Waste* arise from subcategories NFR 6 A *Solid Waste Disposal on Land* and NFR 6 C *Waste Incineration*, which are minor sources with a share of about 0.01% (0.002 Mg) in national total Pb emissions.

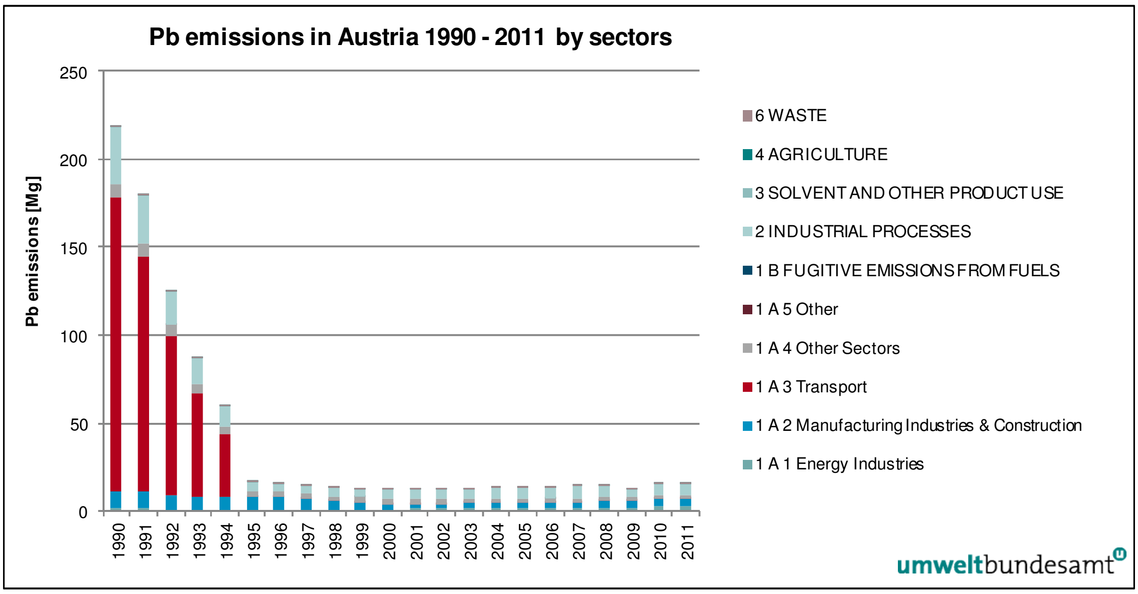


Figure 19: Pb emissions in Austria 1990 - 2011 by sectors in absolute terms

Table 37: Pb emissions per NFR Category 1990 and 2011, their trend 1990–2011 and their share in total emissions.

NFR Category		**Pb Emission in [Mg]**		**Trend**		**Share in National Total**	
		1990	**2011**	**1990–2011**	**2010-2011**	**1990**	**2011**
1	ENERGY	185.819	8.530	-95%	-2%	85%	55%
1 A	FUEL COMBUSTION ACTIVITIES	185.819	8.530	-95%	-2%	85%	55%
1 A 1	Energy Industries	1.082	2.461	128%	-4%	<1%	16%
1 A 1 a	Public Electricity and Heat Production	0.905	2.199	143%	-4%	<1%	14%
1 A 1 b	Petroleum refining	0.177	0.263	49%	-1%	<1%	2%
1 A 1 c	Manufacture of Solid fuels & Other Energy Ind.	NA	NA	NA	NA	NA	NA
1 A 2	Manufacturing Industries and Construction	9.681	3.992	-59%	5%	4%	26%
1 A 2 a	Iron and Steel	0.265	0.163	-39%	3%	<1%	1%
1 A 2 b	Non-ferrous Metals	4.082	1.052	-74%	<1%	2%	7%
1 A 2 c	Chemicals	0.206	0.404	96%	1%	<1%	3%
1 A 2 d	Pulp, Paper and Print	0.618	0.840	36%	<1%	<1%	5%
1 A 2 e	Food Processing, Beverages and Tobacco	0.005	0.002	-60%	-7%	<1%	<1%
1 A 2 f	Other	4.504	1.530	-66%	15%	2%	10%
1 A 3	Transport	167.476	0.012	-100%	-3%	76%	<1%
1 A 3 a	Civil Aviation	1.726	0.000	-100%	17%	1%	<1%
1 A 3 b	Road Transportation	165.464	0.011	-100%	-4%	76%	<1%
1 A 3 c	Railways	0.006	0.000	-93%	2%	<1%	<1%
1 A 3 d	Navigation	0.279	0.000	-100%	-7%	<1%	<1%
1 A 3 e	Pipeline compressors	NA	NA	NA	NA	NA	NA
1 A 4	Other Sectors	7.580	2.065	-73%	-11%	3%	13%
1 A 4 a	Commercial/Institutional	0.454	0.159	-65%	-14%	<1%	1%
1 A 4 b	Residential	6.070	1.721	-72%	-11%	3%	11%
1 A 4 c	Agriculture/Forestry/Fisheries	1.057	0.185	-83%	-11%	<1%	1%
1 A 5	Other	0.000	0.000	33%	1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	NA	NA	NA	NA	NA	NA
2	INDUSTRIAL PROCESSES	32.093	6.860	-79%	3%	15%	44%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	0.001	0.001	-29%	1%	<1%	<1%
2 C	METAL PRODUCTION	32.092	6.859	-79%	3%	15%	44%
2 D	OTHER PRODUCTION	NA	NA	NA	NA	NA	NA
3	SOLVENT AND OTHER PRODUCT USE	0.020	0.020	<1%	<1%	<1%	<1%
4	AGRICULTURE	0.011	0.007	-37%	-12%	<1%	<1%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRI. RESIDUES	0.011	0.007	-37%	-12%	<1%	<1%
4 G	Agriculture OTHER	NA	NA	NA	NA	NA	NA
6	WASTE	1.016	0.002	-100%	-2%	<1%	<1%
6 A	SOLID WASTE DISPOSAL ON LAND	0.001	0.001	-62%	-7%	<1%	<1%
6 B	WASTEWATER HANDLING	NA	NA	NA	NA	NA	NA
6 C	WASTE INCINERATION	1.014	0.001	-100%	<1%	<1%	<1%
6 D	OTHER WASTE	NA	NA	NA	NA	NA	NA
	Total without sinks	**218.959**	**15.419**	**-93%**	**<1%**		

2.4 Emission Trends for POPs

Emissions of Persistent Organic Pollutants (POPs) decreased remarkably from 1985 to 2011. In 2011 the emissions from POPs are below the level of 2009 (economic crisis) due to mild temperatures and thus a lower heating demand. As can be seen in Table 27, emissions for all three POPs are well below their 1985 level, which is the obligation for Austria as a Party to the POPs Protocol (see Chapter 1.1.1).

The most important source for POPs in Austria is residential heating. In the 80s industry and waste incineration were still important sources regarding POP emissions. Due to legal regulations concerning air quality emissions from industry and waste incineration decreased remarkably from 1990 to 1993, which is the main reason for the overall decrease in national total POP emissions.

POP emissions from NFR Category 3 *Solvent and Other Product Use* arose from 3 B and 3 D 2, where emissions of PAH stopped in 1997, emissions of dioxin/furan (PCDD/F) stopped in 1993 and emissions of HCB stopped in 2001.

Table 38: Emissions and emission trends for POPs 1985 – 2011.

Year	**Emission**		
	PAH [Mg]	**PCDD/F [g]**	**HCB [kg]**
1985	26.439	187.137	106.317
1986	25.603	186.046	103.766
1987	25.459	188.043	106.576
1988	24.532	173.367	98.074
1989	23.987	164.430	94.841
1990	16.919	160.760	91.956
1991	17.560	135.467	84.637
1992	12.787	76.918	69.708
1993	10.090	67.125	64.025
1994	9.081	56.357	51.956
1995	9.423	58.583	53.106
1996	10.098	59.935	55.818
1997	9.072	59.400	51.923
1998	8.766	56.297	49.167
1999	8.763	53.655	47.572
2000	8.213	52.055	44.244
2001	8.626	53.009	45.792
2002	8.195	39.917	41.981
2003	8.224	39.462	40.882
2004	8.347	39.966	40.787
2005	8.899	43.004	45.459
2006	7.997	39.784	41.913
2007	7.851	38.445	40.844
2008	7.847	38.550	41.313
2009	7.376	35.482	38.177
2010	8.100	40.006	43.502
2011	7.026	35.448	37.441
Trend 1985–2011	**-73%**	**-81%**	**-65%**
Trend 1990–2011	**-58%**	**-78%**	**-59%**

2.4.1 Polycyclic Aromatic Hydrocarbons (PAH) Emissions

The polycyclic aromatic hydrocarbons (PAH) are molecules built up of benzene rings which resemble fragments of single layers of graphite. PAHs are a group of approximately 100 compounds. Most PAHs in the environment arise from incomplete burning of carbon-containing materials like oil, wood, garbage or coal. Fires are able to produce fine PAH particles, they bind to ash particles and sometimes move long distances through the air. Thus PAHs have been ubiquitously distributed in the natural environment since thousands of years.

Out of all different compounds of the pollutant group of PAHs, the four compounds benz(a)pyren, benzo(b)fluoranthen, benzo(k)fluoranthen and indeno(1,2,3-cd)pyren are used as indicators for the purposes of emission inventories, which has been specified in the UNECE POPs Protocol mentioned above.

PAH emissions and emission trends in Austria

In 1985 national total PAH emissions amounted to about 26 Mg and amounted to about 17 Mg in 1990; emissions have decreased steadily and by the year 2011 emissions were reduced by about 73% (to 7 Mg in 2011) in the period 1985 to 2011. The overall emission trend was about -58% for the period 1990 – 2011.

In 1985 the main emission sources for PAH emissions were the NFR 1 A *Fuel Combustion Activities* (45%), Industrial processes (27%) and Agriculture (27%). In 1990 the main source regarding PAH emissions is NFR 1 A *Fuel Combustion Activities* with a share in the national total of 56%, Industrial processes (41%), Agriculture (1%) and Waste (<1%). From 1990 to 2011 PAH emissions from Agriculture decreased remarkably by 52% due to prohibition of open field burning, PAH emissions from the sector Industrial processes decreased by 97% due to the shut down of primary aluminium production in Austria, which was a main source for PAH emissions.

PAH Emission Trends in NFR Category 1 A Fuel Combustion Activities

The NFR 1 A *Fuel Combustion Activities* is an important source for POP emissions in Austria. Several sub categories are key sources of the Austrian Inventory regarding all three reported POP. As shown in Table 39 in the period from 1990 to 2011 PAH emissions decreased by about 30% to 6.7 Mg, which is a share of 95% in national total PAH emission in 2011.

In 2011 within the NFR category *1 A 4 Other Sectors* has the highest contribution (68%) to PAH emissions, where biomass is mainly used for space and water heating in the commercial, agricultural and household sector. Emissions of NFR *1 A 3 Transport* contributes 23% to national PAH emissions.

PAH Emission Trends in NFR Category 2 Industrial Processes

The PAH emissions are rated as key sources in NFR Category *2 Industrial Processes*. As shown in Table 39 in the period 1990 to 2011 the PAH emissions decreased by 97% to 0.23 Mg, which is a share of about 3% to the total PAH emissions. The main source for PAH emissions of NFR Category 2 *Industrial Processes* was the sub sectors NFR *2 C Metal Production*. The sub sectors NFR 2 C *Metal Production* covers activities reported under NFR 2 C 1 *Iron and steel* and NFR 2 C 3 *Aluminium production*. Aluminium production was stopped in 1992, which explains the strong decrease of PAH emissions.

PAH Emission Trend in NFR Category 3 Solvent Use and Other Product Use

No PAH emissions occur from NFR 3 Solvent Use and Other Product Use.

PAH Emission trend in NFR Category 4 Agriculture

As shown in Table 39 in 2011 in national PAH emissions of the sector *Agriculture* amounted to 0.1 Mg, which is a share of 2% of total PAH emission; emissions decreased by 31% mainly due to reduced burning of agricultural wastes (straw, residual wood) on fields. Within this source *Field burning of agricultural residues* (NFR 4 F) is the only source.

PAH Emission trend in NFR Category 6 Waste

Emissions of PAH from Sector NFR *6 Waste* is only a minor source with the share of less than 0.1% (<0.01 Mg) in total PAH emissions.

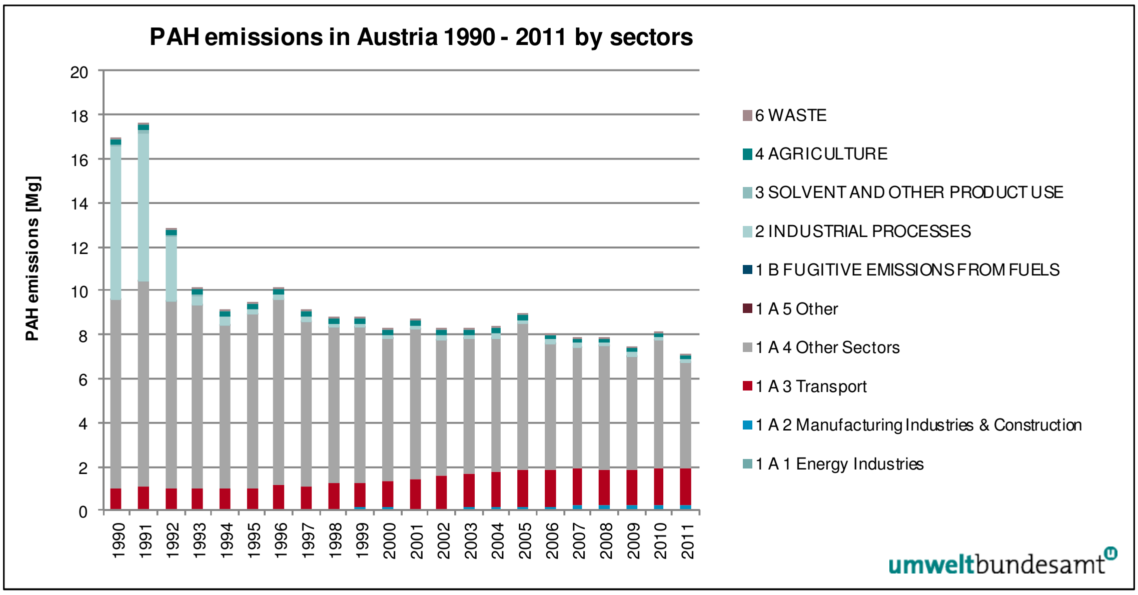


Figure 20: PAH emissions in Austria 1990 - 2011 by sectors in absolute terms

Table 39: PAH emissions per NFR Category 1990 and 2011, their trend 1990–2011 and their share in total emissions.

NFR Category		**PAH Emission in [Mg]**		**Trend**		**Share in National Total**	
		1990	**2011**	**1990–2011**	**2010-2011**	**1990**	**2011**
1	ENERGY	9.54	6.68	-30%	-13%	56%	95%
1 A	FUEL COMBUSTION ACTIVITIES	9.54	6.68	-30%	-13%	56%	95%
1 A 1	Energy Industries	0.01	0.02	350%	-10%	<1%	<1%
1 A 2	Manufacturing Industries and Construction	0.07	0.26	272%	6%	<1%	4%
1 A 2 a	Iron and Steel	0.00	0.00	-19%	-1%	<1%	<1%
1 A 2 b	Non-ferrous Metals	0.00	0.00	-37%	2%	<1%	<1%
1 A 2 c	Chemicals	0.02	0.03	43%	-1%	<1%	<1%
1 A 2 d	Pulp, Paper and Print	0.00	0.00	32%	-3%	<1%	<1%
1 A 2 e	Food Processing, Beverages and Tobacco	0.00	0.00	-47%	-3%	<1%	<1%
1 A 2 f	Other	0.05	0.22	395%	8%	<1%	3%
1 A 3	Transport	0.93	1.61	72%	-4%	6%	23%
1 A 3 a	Civil Aviation	NE	NE	NE	NE	NE	NE
1 A 3 b	Road Transportation	0.91	1.59	75%	-4%	5%	23%
1 A 3 c	Railways	0.02	0.01	-32%	-1%	<1%	<1%
1 A 3 d	Navigation	0.00	0.00	7%	-10%	<1%	<1%
1 A 3 e	Pipeline compressors	NA	NA	NA	NA	NA	NA
1 A 4	Other Sectors	8.53	4.79	-44%	-17%	50%	68%
1 A 4 a	Commercial/Institutional	0.16	0.08	-53%	-15%	1%	1%
1 A 4 b	Residential	7.95	4.10	-48%	-18%	47%	58%
1 A 4 c	Agriculture/Forestry/Fisheries	0.42	0.61	46%	-13%	2%	9%
1 A 5	Other	0.00	0.00	-5%	-1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	NA	NA	NA	NA	NA	NA
1 B 1	Solid fuels	NA	NA	NA	NA	NA	NA
1 B 2	Oil and natural gas	IE	IE	IE	IE	IE	IE
2	INDUSTRIAL PROCESSES	6.98	0.23	-97%	3%	41%	3%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	NE	NE	NE	NE	NE	NE
2 C	METAL PRODUCTION	6.44	0.19	-97%	3%	38%	3%
2 C 1	Iron and Steel Production	0.35	0.19	-45%	3%	2%	3%
2 C 2	Ferroalloys Production	NE	NE	NE	NE	NE	NE
2 C 3	Aluminium production	6.09	NO	NO	NO	36%	NO
2 C 5	Other metal production	IE	IE	IE	IE	IE	IE
2 D	OTHER PRODUCTION	0.55	0.04	-93%	<1%	3%	1%
3	SOLVENT AND OTHER PRODUCT USE	0.15	NE	NE	NE	1%	NE
4	AGRICULTURE	0.25	0.12	-52%	-31%	1%	2%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRICULTURAL RESIDUES	0.25	0.12	-52%	-31%	1%	2%
4 G	Agriculture OTHER	NA	NA	NA	NA	NA	NA
6	WASTE	0.00	0.00	-95%	<1%	<1%	<1%
	Total without sinks	**16.92**	**7.03**	**-58%**	**-13%**		

2.4.2 Dioxins and Furan (PCDD/F)

Dioxins form a family of toxic chlorinated organic compounds that share certain chemical structures and biological characteristics. Several hundred of these compounds exist and are members of three closely related families: the chlorinated dibenzo(p)dioxins (CDDs), chlorinated dibenzofurans (CDFs) and certain polychlorinated biphenyls (PCBs). Dioxins bio-accumulate in humans and wildlife due to their fat solubility and 17 of these compounds are especially toxic.

Dioxins are formed as a result of combustion processes such as commercial or municipal waste incineration and from burning fuels like wood, coal or oil as a main source of dioxins. Dioxins can also be formed when household trash is burned and as a result of natural processes such as forest fires. Dioxins enter the environment also through the production and use of organochlorinated compounds: chlorine bleaching of pulp and paper, certain types of chemical manufacturing and processing, and other industrial processes are able to create small quantities of dioxins. Cigarette smoke also contains small amounts of dioxins.

Thanks to stringent legislation and modern technology dioxin emissions due to combustion and incineration as well as due to chemical manufacturing and processes have been reduced dramatically. Nowadays domestic combustion as well as thermal processes in metals extraction and processing have become more significant.

Dioxin/Furan (PCDD/F) emissions and emission trends in Austria

In 1985 national total dioxin/furan (PCDD/F) emissions amounted to about 187 g and amounted to about 161 g in 1990; emissions have decreased steadily and by the year 2011 emissions were reduced by about 81% (to 35 g in 2011). The overall emission trend in the period 1990 to 2011 was -78%.

In 1985 the main sources for dioxin/furan (PCDD/F) emissions were NFR 1 A *Fuel Combustion Activities* (59%) and *Industrial Processes* (especially iron and steel production) (27%). In 1990 the main sources for dioxin/furan (PCDD/F) emissions were NFR 1 A *Fuel Combustion Activities* (64%) and *Industrial Processes* (especially iron and steel production) (24%). In 2011 the main sector regarding dioxin/furan (PCDD/F) emissions is NFR 1 A *Fuel Combustion Activities* with a share in National Total of 90%.

From 1985 to 2011 dioxin/furan (PCDD/F) emissions from the sectors *Waste* and *Solvents and Other Product Use* decreased by almost 100% due to stringent legislation and modern technology. The dioxin/furan (PCDD/F) emissions of the sectors *Agriculture* and *Industrial processes* decreased significantly due to prohibition of open field burning and improved emission abatement technologies in iron and steel industries.

Dioxin/Furan (PCDD/F) Emission Trends in NFR Category 1 A Fuel Combustion Activities

The NFR 1 A *Fuel Combustion Activities* is also an important source for POP emissions in Austria. Several sub categories are key sources of the Austrian Inventory regarding all three reported POP. As shown in Table 40 in the period from 1990 to 2011 dioxin/furan (PCDD/F) emissions decreased by about 69% to 32 g, which is a share of 90% in national total dioxin/furan (PCDD/F) emissions in 2011.

Within this source NFR *1 A 4 Other Sectors* has the highest contribution (64%) to dioxin/furan (PCDD/F) emissions due to biomass heatings. Emissions of NFR *1 A 2 Manufacturing Industries and Constrution* amount to 20% of national dioxin/furan (PCDD/F) emissions.

Dioxin/Furan (PCDD/F) Emission Trends in NFR Category 2 Industrial Processes

The dioxin/furan (PCDD/F) emissions are rated as key sources in NFR Category *2 Industrial Processes*. As shown in Table 40 in the period 1990 to 2011 the dioxin/furan (PCDD/F) emissions decreased by 92% to 3.2 g, which is a share of 9% to the total PCDD/F emissions. The main source for POP emissions of NFR Category 2 *Industrial Processes* was the sub sectors NFR *2 C Metal Production.* Dioxin/furan (PCDD/F) emissions decreased significantly due to extensive abatement measures.

Small source for persistent organic pollutant dioxin/furan (PCDD/F) emissions of NFR Category *2 Industrial Processes* were the sub sector NFR 2 D *Other Production* which covers activities of NFR 2 D 2 *Food and Drink* (meat and fish smoking).

Dioxin/Furan (PCDD/F) Emission Trend in NFR Category 3 Solvent Use and Other Product Use

No Dioxin/Furan (PCDD/F) emissions occur from NFR 3 Solvent Use and Other Product Use in 2011.

Dioxin/Furan (PCDD/F) Emission trend in NFR Category 4 Agriculture

As shown in Table 40 in the period from 1990 to 2011 dioxin/furan (PCDD/F) emissions decreased by 51% to 0.1 g, which is a share of less than 1% in total PCDD/F emission, mainly due to reduced burning of agricultural wastes (straw, residual wood) on fields. Within this source *Field burning of agricultural residues* (NFR 4 F) is the only source.

Dioxin/Furan (PCDD/F) Emission trend in NFR Category 6 Waste

Emissions of dioxin/furan (PCDD/F) from Sector NFR *6 Waste* are not rated as key sources of the Austrian Inventory. As shown in Table 40 in the period from 1990 to 2011 dioxin/furan emissions decreased by about 99% to 0.16 g, which is a share of less than 1% in total dioxin/furan emissions, whereas in 1990 dioxin/furan (PCDD/F) emissions contribute 11% to the total dioxin/furan emissions.

Within this source the NFR Sector 6 C *waste incineration* is the only source of POP emissions.

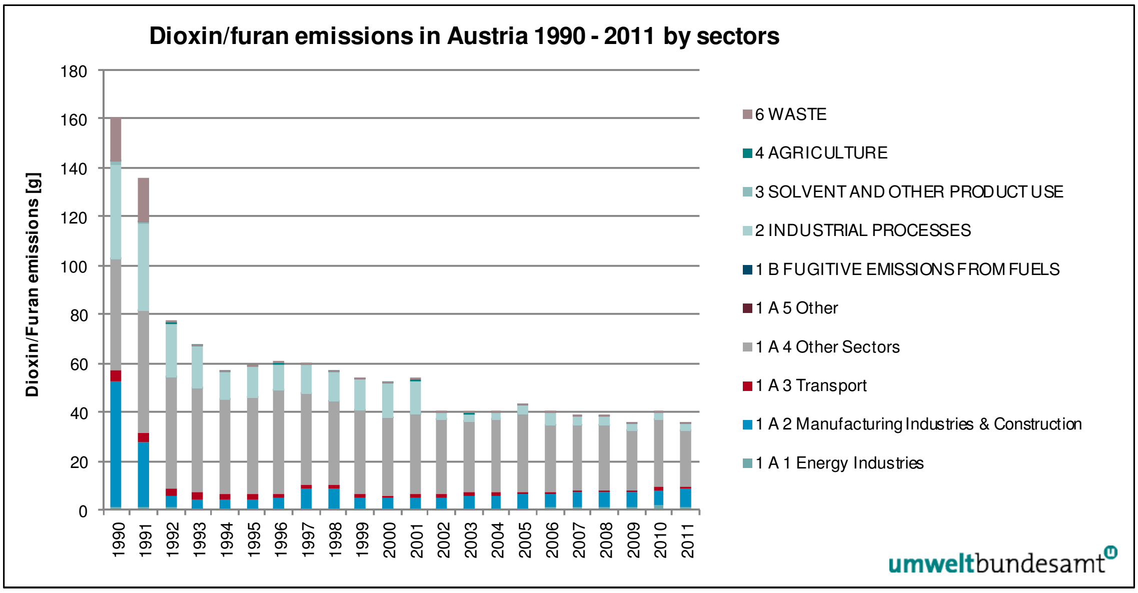


Figure 21: Dioxin/Furan emissions in Austria 1990 - 2011 by sectors in absolute terms

Table 40: Dioxin/Furan (PCDD/F) emissions per NFR Category 1990 and 2011, their trend 1990 – 2011 and their share in total emissions.

NFR Category		**Dioxin Emission in [g]**		**Trend**		**Share in National Total**	
		1990	**2011**	**1990–2011**	**2010-2011**	**1990**	**2011**
1	ENERGY	102.32	32.04	-69%	-12%	64%	90%
1 A	FUEL COMBUSTION ACTIVITIES	102.32	32.04	-69%	-12%	64%	90%
1 A 1	Energy Industries	0.82	1.45	77%	-4%	1%	4%
1 A 2	Manufacturing Industries and Construction	52.10	7.04	-86%	6%	32%	20%
1 A 2 a	Iron and Steel	0.03	0.03	-25%	4%	0%	0%
1 A 2 b	Non-ferrous Metals	50.34	2.22	-96%	0%	31%	6%
1 A 2 c	Chemicals	0.44	0.63	44%	-1%	0%	2%
1 A 2 d	Pulp, Paper and Print	0.49	0.64	32%	-3%	0%	2%
1 A 2 e	Food Processing, Beverages and Tobacco	0.03	0.02	-29%	-6%	0%	0%
1 A 2 f	Other	0.77	3.51	354%	14%	0%	10%
1 A 3	Transport	3.94	1.04	-74%	-5%	2%	3%
1 A 3 a	Civil Aviation	NE	NE	NE	NE	NE	NE
1 A 3 b	Road Transportation	3.89	1.01	-74%	-5%	2%	3%
1 A 3 c	Railways	0.04	0.01	-66%	0%	0%	0%
1 A 3 d	Navigation	0.01	0.01	-7%	-6%	0%	0%
1 A 3 e	Pipeline compressors	0.00	0.00	75%	23%	0%	0%
1 A 4	Other Sectors	45.46	22.51	-50%	-17%	28%	64%
1 A 4 a	Commercial/Institutional	1.92	1.23	-36%	-14%	1%	3%
1 A 4 b	Residential	41.79	18.78	-55%	-18%	26%	53%
1 A 4 c	Agriculture/Forestry/Fisheries	1.76	2.50	42%	-14%	1%	7%
1 A 5	Other	0.00	0.00	-5%	-1%	0%	0%
1 B	FUGITIVE EMISSIONS FROM FUELS	NA	NA	NA	NA	NA	NA
2	INDUSTRIAL PROCESSES	39.00	3.15	-92%	-6%	24%	9%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	NA	NA	NA	NA	NA	NA
2 C	METAL PRODUCTION	37.21	3.02	-92%	-6%	23%	9%
2 C 1	Iron and Steel Production	37.21	3.02	-92%	-6%	23%	9%
2 C 2	Ferroalloys Production	NE	NE	NE	NE	NE	NE
2 C 3	Aluminium production	0.00	NO	NO	NO	0%	NO
2 C 5	Other metal production	IE	IE	IE	IE	IE	IE
2 D	OTHER PRODUCTION	1.79	0.13	-93%	0%	1%	0%
3	SOLVENT AND OTHER PRODUCT USE	1.06	NE	NE	NE	1%	NE
4	AGRICULTURE	0.18	0.09	-51%	-29%	0%	0%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRICULTURAL RESIDUES	0.18	0.09	-51%	-29%	0%	0%
4 G	Agriculture OTHER	NA	NA	NA	NA	NA	NA
6	WASTE	18.19	0.16	-99%	0%	11%	0%
	Total without sinks	**160.76**	**35.45**	**-78%**	**-11%**		

2.4.3 Hexachlorobenzene (HCB) Emissions

Hexachlorobenzene (HCB) has been widely employed as a fungicide on seeds, especially against the fungal disease 'bunt' that affects some cereal crops. The marketing and use of hexachlorobenzene as a plant protection product was banned in the European Union in 1988.

As there is no more hexachlorobenzene production in the EU, the only man-made releases of hexachlorobenzene are as unintentional by-product; it is emitted from the same chemical and thermal processes as Dioxins/Furans (PCDD/F) and formed via a similar mechanism.

It is released to the environment as an unintentional by-product in chemical industry (production of several chlorinated hydrocarbons such as drugs, pesticides or solvents) and in metal industries and is formed in combustion processes in the presence of chlorine.

HCB emissions and emission trends in Austria

In 1985 national total HCB emissions amounted to about 106 kg and amounted to about 92 kg in 1990; emissions have decreased steadily and by the year 2011 emissions were reduced by about 65% (to 37 kg in 2011) in the period from 1985 to 2011. National total emissions decreased by 59% in the period from 1990 to 2011.

In 1985 the two main sources for HCB emissions were the NFR 1 A *Fuel Combustion Activities* (78%) and *Industrial processes* (12%) in National Total HCB emission. In 1990 the two main sources for HCB emissions were the NFR 1 A *Fuel Combustion Activities* (79%) and *Industrial processes* (11%) in National Total HCB emission. In 2011 the main sources of HCB emissions was NFR 1 A *Fuel Combustion Activities* (89%) in National Total HCB emission.

From 1985 to 2011 HCB emissions from the sectors NFR 3 Solvents, NFR 4 Agriculture as well as NFR 6 *Waste* decreased remarkably by 100%, 98% and 97%, respectively, more due to stringent legislation and modern technology. HCB emissions of the sectors *Industrial processes* and *Combustion Activities* decreased by 70% and 60%, respectively, due to improved dust abatement technologies.

HCB Emission Trends in NFR Category 1 A Fuel Combustion Activities

The NFR Category 1 A Fuel Combustion Activities is an important source for HCB emissions in Austria. As shown in Table 41 in the period from 1990 to 2011 HCB emissions decreased by about 54% to 33 kg, which is a share of 89% in national total HCB emissions in 2011.

Within this source NFR *1 A 4 Other Sectors* has the highest contribution (83%) to HCB emissions due to biomass heatings.

HCB Emission Trends in NFR Category 2 Industrial Processes

As shown in Table 41 in the period 1990 to 2011 the HCB emissions decreased by 59% to 3.9 kg, which is a share of 11% to the total HCB emissions. The main source for HCB emissions of NFR Category 2 *Industrial Processes* was the sub sectors NFR *2 C Metal Production.* HCB emissions decreased significantly due to extensive abatement measures.

HCB Emission Trend in NFR Category 3 Solvent Use and Other Product Use

No HCB emissions occur from NFR 3 Solvent Use and Other Product Use in 2011.

HCB Emission Trend in NFR Category 4 Agriculture

As shown in Table 41 in the period from 1990 to 2011 HCB emissions decreased by 51% to 0.02 kg, which is a share of less than 0.1% in total HCB emission, mainly due to reduced burning of agricultural wastes (straw, residual wood) on fields. Within this source *Field burning of agricultural residues* (NFR 4 F) is the only source.

HCB Emission Trend in NFR Category 6 Waste

As shown in Table 41 in the period from 1990 to 2011 HCB emissions decreased by about 92% to 0.03 kg, which is a share of about <1% in total HCB emissions.

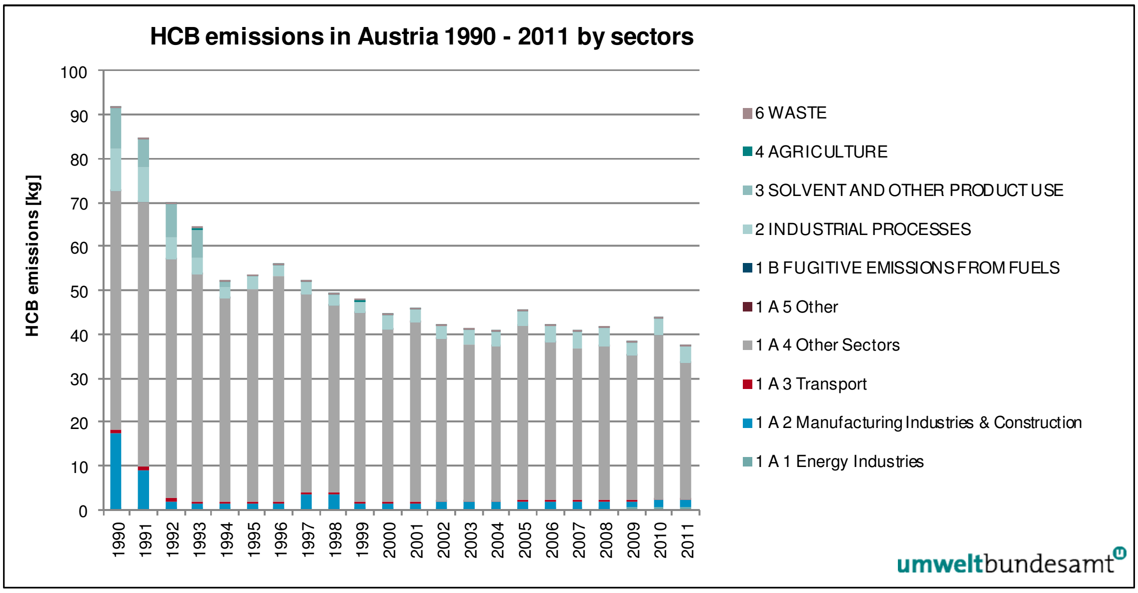


Figure 22: HCB emissions in Austria 1990 - 2011 by sectors in absolute terms

Table 41: Hexachlorbenzene (HCB) emissions per NFR Category 1990 and 2011, their trend 1990–2011 and their share in total emissions.

NFR Category		**HCB Emission in [kg]**		**Trend**		**Share in National Total**	
		1990	**2011**	**1990–2011**	**2010–2011**	**1990**	**2011**
1	ENERGY	72.76	33.46	-54%	-16%	79%	89%
1 A	FUEL COMBUSTION ACTIVITIES	72.76	33.46	-54%	-16%	79%	89%
1 A 1	Energy Industries	0.21	0.50	143%	<1%	<1%	1%
1 A 2	Manufacturing Industries and Construction	17.45	1.79	-90%	4%	19%	5%
1 A 2 a	Iron and Steel	0.01	0.00	-30%	3%	<1%	<1%
1 A 2 b	Non-ferrous Metals	17.15	1.00	-94%	<1%	19%	3%
1 A 2 c	Chemicals	0.07	0.10	47%	-1%	<1%	<1%
1 A 2 d	Pulp, Paper and Print	0.10	0.13	32%	-3%	<1%	<1%
1 A 2 e	Food Processing, Beverages and Tobacco	0.00	0.00	-33%	-6%	<1%	<1%
1 A 2 f	Other	0.13	0.56	329%	14%	<1%	1%
1 A 3	Transport	0.79	0.21	-74%	-5%	1%	1%
1 A 3 a	Civil Aviation	NE	NE	NE	NE	NE	NE
1 A 3 b	Road Transportation	0.78	0.20	-74%	-5%	1%	1%
1 A 3 c	Railways	0.01	0.00	-66%	<1%	<1%	<1%
1 A 3 d	Navigation	0.00	0.00	-7%	-6%	<1%	<1%
1 A 3 e	Pipeline compressors	0.00	0.00	75%	23%	<1%	<1%
1 A 4	Other Sectors	54.31	30.96	-43%	-17%	59%	83%
1 A 4 a	Commercial/Institutional	1.45	0.72	-50%	-14%	2%	2%
1 A 4 b	Residential	50.30	26.28	-48%	-17%	55%	70%
1 A 4 c	Agriculture/Forestry/Fisheries	2.56	3.95	54%	-14%	3%	11%
1 A 5	Other	0.00	0.00	-5%	-1%	<1%	<1%
1 B	FUGITIVE EMISSIONS FROM FUELS	NA	NA	NA	NA	NA	NA
2	INDUSTRIAL PROCESSES	9.71	3.93	-59%	3%	11%	11%
2 A	MINERAL PRODUCTS	NA	NA	NA	NA	NA	NA
2 B	CHEMICAL INDUSTRY	1.26	NA	NA	NA	1%	NA
2 C	METAL PRODUCTION	8.09	3.91	-52%	3%	9%	10%
2 C 1	Iron and Steel Production	8.09	3.91	-52%	3%	9%	10%
2 C 2	Ferroalloys Production	NE	NE	NE	NE	NE	NE
2 C 3	Aluminium production	NA	NO	NO	NO	NA	NO
2 C 5	Other metal production	IE	IE	IE	IE	IE	IE
2 D	OTHER PRODUCTION	0.36	0.03	-93%	<1%	<1%	<1%
3	SOLVENT AND OTHER PRODUCT USE	9.05	NE	NE	NE	10%	NE
4	AGRICULTURE	0.04	0.02	-51%	-29%	<1%	<1%
4 B	MANURE MANAGEMENT	NA	NA	NA	NA	NA	NA
4 D	AGRICULTURAL SOILS	NA	NA	NA	NA	NA	NA
4 F	FIELD BURNING OF AGRICULTURAL RESIDUES	0.04	0.02	-51%	-29%	<1%	<1%
4 G	Agriculture OTHER	NA	NA	NA	NA	NA	NA
6	WASTE	0.39	0.03	-92%	<1%	<1%	<1%
	Total without sinks	**91.96**	**37.44**	**-59%**	**-14%**		

3 ENERGY (NFR SECTOR 1)

Sector *1 Energy* considers emissions originating from *fuel combustion activities*

- 1 A 1 Energy Industries
- 1 A 2 Manufacturing Industries and Construction
- 1 A 3 Transport
- 1 A 4 Other Sectors (commercial and residential)
- 1 A 5 Other (Military)

as well as fugitive emissions from fuels (NFR 1 B)

- 1 B 1 Solid fuels
- 1 B 2 Oil and natural gas.

3.1 NFR 1 A Stationary Fuel Combustion Activities

3.1.1 Gerneral discription

This chapter gives an overview of category *1 A Stationary Fuel Combustion Activities*. It includes information on completeness, QA/QC and planned improvements as well as on emissions, emission trends and methodologies applied (including emission factors).

Information is also provided in the Austrian National Inventory Report 2013 (UMWELTBUNDESAMT 2013a) which is part of the submission under the UNFCCC.

- Additionally to information provided in this document, Annex 2 of (UMWELTBUNDESAMT 2013a) includes further information on the underlying activity data used for emissions estimation. It describes the national energy balance (fuels and fuel categories, net calorific values) and the methodology of how activity data are extracted from the energy balance (correspondence of energy balance to SNAP and IPCC categories).
- National energy balance data are presented in Annex 4 of (UMWELTBUNDESAMT 2013a).

Completeness

Table 42 provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated.

Table 42: Completeness of "1 A Stationary Fuel Combustion Activities".

NFR Category	**NO_x**	**CO**	**NMVOC**	**SO_x**	**NH_3**	**TSP**	**PM10**	**PM2.5**	**Pb**	**Cd**	**Hg**	**DIOX**	**PAH**	**HCB**
1 A 1 a Public Electricity and Heat Production	✓	✓	✓	✓	✓ NE(3)	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 1 b Petroleum refining	✓	✓	IE(1)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 1 c Manufacture of Solid fuels and Other Energy Industries	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)	✓ IE(4)
1 A 2 a Iron and Steel	✓	✓	✓	✓	✓	✓ IE(5)	✓ IE(5)	✓ IE(5)	✓ IE(5)	✓ IE(5)	✓ IE(5)	✓ IE(5)	✓ IE(5)	✓ IE(5)
1 A 2 b Non-ferrous Metals	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 2 c Chemicals	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 2 d Pulp, Paper and Print	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 2 e Food Processing, Beverages and Tobacco	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 2 f Other	✓	✓	✓	✓	✓	✓ (8)	✓ (8)	✓ (8)	✓	✓	✓	✓	✓	✓
1 A 3 e i Pipeline compressors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NE (6)	NA (7)	✓
1 A 4 a Commercial/Institutional	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 4 b i Residential plants	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 4 c i Agriculture/ Forestry/Fishing, Stationary	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 5 a Other, Stationary (including Military)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)	IE(2)

(1) *NMVOC emissions from Petroleum Refining are included in 1 B.*

(2) *Emissions from military facilities are included in 1 A 4 a.*

(3) *NH_3 slip emissions from NO_x control are not estimated.*

(4) *Emissions from coke ovens are included in 1 A 2 a or 2 C 1. Emissions from final energy use of coal mines are included in 1 A 2 f.*

(5) *Heavy metals, POPs and PM emissions from integrated iron and steel plants are included in 2 C 1.*

(6) *Dioxin emissions (PCDD/F) from natural gas compressors are not estimated but assumed to be negligible (at level of detection limit).*

(7) *PAH emissions from natural gas compressors are assumed to be negligible (below detection limit).*

(8) *PM emissions from cement and lime kilns are inluded in 2 A 1 and 2 A 3.*

Table 43 shows the correspondence of NFR and SNAP categories.

Table 43: NFR and SNAP categories of "1 A Stationary Fuel Combustion Activities".

NFR Category		**SNAP**
1 A 1 a Public Electricity and Heat Production	0101 0102	Public power District heating plants
1 A 1 b Petroleum refining	0103	Petroleum refining plants
1 A 1 c Manufacture of Solid fuels and Other Energy Industries	0104 010503 010504	Solid fuel transformation plants Oil/Gas Extraction plants Gas Turbines
1 A 2 a Iron and Steel	0301 030302 030326	Comb. In boilers, gas turbines and stationary engines (Iron and Steel Industry) Reheating furnaces steel and iron Processes with Contact-Other(Iron and Steel Industry)
1 A 2 b Non-ferrous Metals	0301 030307 030309 030310 030324	Comb. In boilers, gas turbines and stationary engines (Non-ferrous Metals Industry) Secondary lead production Secondary copper production Secondary aluminium production Nickel production (thermal process)
1 A 2 c Chemicals	0301	Comb. in boilers, gas turbines and stationary engines (Chemicals Industry)
1 A 2 d Pulp, Paper and Print	0301	Comb. in boilers, gas turbines and stationary engines (Pulp, Paper and Print Industry)
1 A 2 e Food Processing, Beverages and Tobacco	0301	Comb. in boilers, gas turbines and stationary engines (Food Processing, Beverages and Tobacco Industry)
1 A 2 f ii Other Stationary in Industry	0301 030311 030317 030312 030319 030323	Comb. in boilers, gas turbines and stationary engines (Industry not included in 1 A 2 a to 1 A 2 e) Cement Glass Lime Bricks and Tiles Magnesium production (dolomite treatment)
1 A 3 e i Pipeline compressors	010506	Pipeline Compressors
1 A 4 a Commercial/Institutional	0201	Commercial and institutional plants Open Firepits and Bonfires
1 A 4 b I Residential plants	0202	Residential plants Barbecue
1 A 4 c ii Agriculture/Forestry/ Fisheries –Stationary	0203	Plants in agriculture, forestry and aquaculture

3.1.2 Methodological issues

General Methodology for stationary sources of NFR categories 1 A 1 to 1 A 5

For large point sources in categories 1 A 1 a, 1 A 1 b, 1 A 2 a, 1 A 2 d and 1 A 2 f (cement industry) emission measurements of NO_x, SO_2 ,NMVOC, CO and TSP are the basis for the reported emissions.

The remaining sources (area sources), where measured (plant-specific) emission data and plant specific activity data is not available, were estimated using the simple CORINAIR methodology by multiplying the fuel consumption of each sub category taken from the national energy balance with a fuel and technology dependent emission factor. Fuel specific emission factors are mainly country specific and taken from national studies.

Emission factors

Emission factors are expressed as: kg released pollutant per TJ of burned fuel [kg/TJ].

Emission factors may vary over time for the following reasons:

- The chemical characteristics of a fuel category varies, e.g. sulphur content in residual oil.
- The mix of fuels of a fuel category changes over time. If the different fuels of a fuel category have different calorific values and their share in the fuel category changes, the calorific value of the fuel category might change over time. If emission factors are in the unit kg/t the transformation to kg/TJ induces a different emission factor due to varying net calorific values.
- The (abatement-) technology of a facility – or of facilities – changes over time.

Sources of NO_x, SO_2, VOC, CO, and TSP emission factors have been periodically published reports (BMWA 1990), (BMWA 1996), (UMWELTBUNDESAMT 2001a), (UMWELTBUNDESAMT 2004b). In these studies emission factors are provided for the years 1987, 1995 and 1996. Emission factors are mainly based on country specific measurements. NH_3 emission factors are taken from a national study (UMWELTBUNDESAMT 1993) and (EMEP/CORINAIR 2005, chapter B112). Details are included in the relevant chapters.

NH_3

Emission factors are constant for the whole time series.

SO_2, NO_x, NMVOC, CO

For the years 1990 to 1994 emission factors are linearly interpolated by using the emission factors from 1987 and 1995 taken from the studies mentioned above. From 1997 onwards mainly the emission factors of 1996 are used.

In several national studies only emission factors for VOC are cited. NMVOC emissions are calculated by subtracting a certain share of CH_4 emissions from VOC emissions.

Characteristic of oil products

According to a national standard, residual fuel oil is classified into 3 groups with different sulphur content (heavy, medium, light). Consumption of special residual fuel oil with a sulphur content higher than 1% is limited to special power plants ≥ 50 MW and the oil refinery. Heating fuel oil is mainly used for space heating in small combustion plants. The following Table shows the sulphur contents of oil products which decreased strongly since 1980 due to legal measures. The years presented in the table are the years where leagal measures came into force.

Table 44: Limited sulphur content of oil product classes according to the Austrian standard „ÖNORM".

Year	Residual fuel oil "Heavy"	Residual fuel oil "Medium"	Residual fuel oil "Light"	Heating fuel oil
1980	3.5%	2.5%	1.50%	0.8%
1981				0.5%
1982		1.5%	0.75%	
1983	3.0%			0.3%
1984	2.5%; 2.0%	1.0%	0.50%	
1985				
1987		0.6%		
1989			0.30%	0.2%
1990			0.20%	0.1%
1992	1.0%			
1994		0.4%		

Since the year 2008 a new gasoil product was introduced in Austria with a maximum sulphur content of 10 ppm (0.001%) which has the same quality as transport diesel. In the inventory it is assumed that the new product has a 100% market share since 2009 because of it's lower taxes.

Activity data

A description of methodology and activity data is provided in (UMWELTBUNDESAMT 2013a). If the energy balance reports fuel quantities by mass or volume units the fuel quantities must be converted into energy units [TJ] by means of net calorific values (NCV) which are provided by Statistik Austria along with the energy balance.

Not all categories of the gross inland fuel consumption are combusted or relevant for the inventory:

- Emissions from international bunker fuels are not included in the National Total but reported separately as *Memo Item*.
- Avoiding of activity data double counting: transformation and distribution losses and transformations of fuels to other fuels (like hard coal to coke oven coke or internal refinery processes which have been added to the transformation sector of the energy balance) is not considered as activity data.
- Non energy use is also not considered for calculation of emissions in Sector *1 A Energy*. However, from these fuels fugitive emissions might occur which are considered in Sector 3 *Solvents*. Emissions from fuel used as a feedstock are considered in Sector 2 *Industrial Processes*.

Measured emissions

In case that measured emissions are used for inventory preparation it is essential that the correspondent activity data is additionally reported to avoid double counting of emissions within the inventory. Plant or industrial branch specific emissions are mostly broken down to fuel specific emissions per NFR source category. In case that complete time series of measured emission data are not available implied emission factors are used for emission calculation. Implied emission factors may also be used for validation of measured emissions.

3.1.3 NFR 1 A 1 Energy Industries

NFR Category *1 A 1* comprises emissions from fuel combustion for *public electricity and heat production* (NFR 1 A 1 a), in *petroleum refining* (NFR 1 A 1 b), and in manufacture of solid fuels and other energy industries (NFR 1 A 1 c).

General Methodology

The following Table 45 gives an overview of methodologies and data sources of sub category *1 A 1 Energy Industries*.

Table 45: Overview of 1 A 1 methodologies for main pollutants.

	Activity data	**Reported/measured emissions**	**Emission factors**
1 A 1 a boilers ≥ 50 MW_{th}	Reporting Obligation: fuel consumption (monthly). 2005–2011: ETS data	Reporting Obligation: NO_x, SO_2, TSP, CO (monthly) (56 boilers)	NMVOC, NH_3: national studies
1 A 1 a boilers < 50 MW_{th}	Energy balance 2005–2011: ETS data for plants ≥ 20 MW_{th}	Used for deriving emission factors	All pollutants: national studies
1 A 1 b (1 plant)	Reported by plant operator (yearly) 2005–2011: ETS data	Reported by plant operator: SO_2, NO_x, CO, NMVOC (yearly)	NH_3: national study
1 A 1 c	Energy balance 2005–2011: ETS data		All pollutants: national studies

For 2005–2011 activity data from the emission trading system (ETS) has been considered. ETS data fully covers caegory *1 A 1 b*, covers about 65% of category *1 A 1 a* and about 8% of category *1 A 1 c* activity data.

3.1.3.1 NFR 1 A 1 a Public Electricity

In this category large point sources are considered. The Umweltbundesamt operates a database called „Dampfkesseldatenbank*"* (DKDB) which stores plant specific monthly fuel consumption as well as measured CO, NO_x, SO_x and TSP emissions from boilers with a thermal capacity greater than 3 MW_{th} from 1990 to 2006. Since 2007 the reporting has been changed to an online system. To reach consistency with the GHG inventory all ETS plants and additionally 13 waste incineration boilers/kilns are considered as large point sources. These data are used to generate a sectoral split of the categories *Public Power* and *District Heating* into the two categories ≥ *300 MW_{th}* and ≥ *50 MW_{th} to 300 MW_{th}*. Currently 56 boilers are considered in this approach. It turned out that this methodology is appropriate for most cases but overall fuel consumption has to be checked against the national energy balance or other available complete datasets/surveys (see section on QA/QC).

Fuel consumption in the public electricity sector varies strongly over time. The most important reason for this variation is the fact that in Austria up to 78% of yearly electricity production comes from hydropower. If production of electricity from hydropower is low, production from thermal power plants is high and vice versa.

The following table shows the gross electricity and heat production of public power and district heating plants. Increasing district heat production is mainly generated by new biomass (local) heat plants and by waste incineration. The share of combined heat and power plants (CHP generation) is increasing and leads to higher efficiency of energy generation. The year 2010 shows a historic maximum of about 19 TWh electricity and 80 PJ district heat production from fuel combustion.

Table 46: Public gross electricity and heat production.

	Public gross electricity production [GWh]						Public Heat Production [TJ] by Combustible Fuels
	Total	**Hydro**[1]	**Combustible Fuels**	**Geothermal**	**Solar**	**Wind**	
1990	43 403	30 111	13 292	0	0	0	24 427
1991	43 497	30 268	13 229	0	0	0	29 038
1992	42 848	33 530	9 318	0	0	0	27 601
1993	44 809	35 070	9 738	0	1	0	30 428
1994	44 804	34 078	10 725	0	1	0	30 729
1995	47 580	35 431	12 147	0	1	1	34 426
1996	45 953	32 892	13 055	0	1	5	44 483
1997	47 527	34 532	12 973	0	2	20	40 597
1998	47 789	35 596	12 146	0	2	45	43 415
1999	52 192	39 593	12 546	0	2	51	42 465
2000	52 810	41 131	11 609	0	3	67	42 197
2001	53 763	39 681	13 972	0	5	105	44 575
2002	54 385	40 597	13 636	3	9	140	45 056
2003	52 508	34 230	17 888	3	15	372	48 896
2004	56 050	37 700	17 396	2	18	934	51 786
2005	58 097	37 787	18 956	2	21	1 331	56 987
2006	56 075	37 089	17 209	3	22	1 752	55 119
2007	55 914	38 066	15 785	2	24	2 037	54 600
2008	57 951	39 481	16 427	2	30	2 011	61 628
2009	60 597	42 395	16 184	2	49	1 967	62 003
2010	61 727	40 500	19 074	1	89	2 063	80 160
2011	56 319	36 739	17 471	1	174	1 934	74 072

[1] *including pumped storage; Source: STATISTIK AUSTRIA 2012C*

As shown in Table 47 electricity supply increased by 10 708 GWh since 2000 of which approx. 80% has been supplied by additional imports until 2008. The year 2009 shows falling electricity consumption (supply) but an increase of production, mainly by hydro power. The year 2011 shows an historical maximum of net imports which contribute to 12% of total electricity supply.

Table 47: Electricity supply, gross production imports, exports and net imports [GWh].

	Electricity [GWh]				
	Supply[1]	**Gross production**[2]	**Imports**	**Exports**	**Net Imports**
1990	46 489	50 294	6 839	7 298	-459
1991	48 793	51 483	8 503	7 738	765
1992	48 197	51 190	9 175	8 621	554
1993	49 073	52 421	8 072	8 804	-732
1994	49 596	53 132	8 219	9 043	-824
1995	50 979	56 225	7 287	9 757	-2 470

	Electricity [GWh]				
	Supply[1)]	Gross production[2)]	Imports	Exports	Net Imports
1996	52 515	54 880	9 428	8 476	952
1997	53 069	56 704	9 008	9 775	-767
1998	54 039	57 001	10 304	10 467	-163
1999	55 167	60 944	11 608	13 507	-1 899
2000	55 750	61 257	13 824	15 192	-1 368
2001	58 338	62 449	14 467	14 252	215
2002	58 074	62 499	15 375	14 676	699
2003	60 058	60 174	19 003	13 389	5 614
2004	61 320	64 151	16 629	13 548	3 081
2005	62 865	66 409	20 397	17 732	2 665
2006	65 595	64 499	21 257	14 407	6 850
2007	66 706	64 757	22 130	15 511	6 619
2008	66 144	66 877	19 796	14 933	4 863
2009	63 604	69 080	19 542	18 762	780
2010	66 339	71 125	19 898	17 567	2 331
2011	66 458	65 699	24 972	16 777	8 195

Source: Statistik Austria

[1)] *Excluding own use and heat pumps, boilers and pumped storage use. Including losses*

[2)] *Public and autoproducer gross production*

Total fuel consumption data is taken from the energy balance (IEA JQ 2012) prepared by Statistik Austria. The remaining fuel consumption (= total consumption minus reported boiler consumption) is the activity data of plants < 50 MW_{th} used for emission calculation with the simple CORINAIR methodology using national emission factors.

Emissions from this category are presented in the following table.

Table 48: Emissions of SO_2, NO_x, NMVOC, NH_3 and CO as well as PM from NFR 1 A 1 a Public Electricity 1990–2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
			[Gg]				[Mg]	
1990	11.79	12.05	0.42	0.11	1.33	0.81	0.76	0.64
1991	13.31	11.36	0.48	0.12	1.61	NE	NE	NE
1992	5.73	8.82	0.40	0.11	1.29	NE	NE	NE
1993	6.63	7.52	0.41	0.14	0.96	NE	NE	NE
1994	4.68	6.42	0.39	0.14	1.09	NE	NE	NE
1995	5.93	7.62	0.38	0.13	1.68	0.71	0.66	0.56
1996	4.31	6.86	0.41	0.16	1.79	NE	NE	NE
1997	5.42	7.70	0.41	0.16	1.67	NE	NE	NE
1998	3.53	6.52	0.41	0.18	1.48	NE	NE	NE
1999	3.68	6.54	0.37	0.16	1.95	NE	NE	NE
2000	3.68	7.01	0.37	0.14	2.01	0.52	0.48	0.40
2001	4.41	8.34	0.50	0.16	2.40	0.68	0.63	0.53
2002	3.97	7.95	0.47	0.16	2.47	0.67	0.62	0.52

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
	[Gg]					[Mg]		
2003	4.22	9.70	0.55	0.18	2.94	0.84	0.78	0.66
2004	3.43	9.75	0.55	0.19	2.55	0.91	0.84	0.71
2005	3.56	10.44	0.57	0.24	3.04	0.89	0.82	0.69
2006	4.05	10.47	0.68	0.24	3.93	0.98	0.90	0.76
2007	2.69	10.26	0.70	0.26	3.67	1.03	0.94	0.79
2008	2.62	10.67	0.75	0.31	4.17	1.11	1.01	0.85
2009	2.80	9.89	0.83	0.33	4.69	1.16	1.05	0.88
2010	2.93	11.54	0.89	0.40	5.63	1.45	1.31	1.10
2011	2.52	11.06	0.95	0.37	5.32	1.36	1.23	1.03
Trend 1990–2011	-78.6%	-8.2%	128.7%	236.7%	301.0%	68.2%	62.0%	60.8%
Trend 2010–2011	-13.9%	-4.2%	6.8%	-8.6%	-5.5%	-6.3%	-6.3%	-6.5%

Table 49: Emissions of heavy metals and POPs from NFR 1 A 1 a Public Electricity 1990–2011.

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[Mg]	[Mg]	[Mg]	[Mg]	[g]	[kg]
1990	0.104	0.327	0.905	0.003	0.797	0.203
1991	0.112	0.340	0.945	0.004	0.828	0.223
1992	0.077	0.225	0.756	0.004	1.020	0.243
1993	0.070	0.186	0.586	0.006	0.242	0.180
1994	0.059	0.170	0.528	0.006	0.261	0.190
1995	0.059	0.187	0.519	0.006	0.303	0.200
1996	0.060	0.184	0.644	0.006	0.347	0.209
1997	0.058	0.185	0.691	0.007	0.369	0.216
1998	0.051	0.145	0.620	0.008	0.374	0.211
1999	0.064	0.171	0.559	0.008	0.415	0.255
2000	0.059	0.186	0.755	0.007	0.456	0.245
2001	0.075	0.212	0.851	0.009	0.470	0.248
2002	0.075	0.196	0.987	0.009	0.576	0.270
2003	0.084	0.216	1.150	0.010	0.627	0.268
2004	0.077	0.200	1.160	0.010	0.666	0.314
2005	0.090	0.199	1.180	0.011	0.699	0.315
2006	0.094	0.196	1.330	0.012	0.767	0.329
2007	0.100	0.181	1.558	0.014	0.898	0.354
2008	0.116	0.181	1.690	0.016	0.993	0.365
2009	0.133	0.162	1.737	0.019	1.137	0.417
2010	0.162	0.201	2.292	0.025	1.493	0.500
2011	0.153	0.204	2.199	0.022	1.427	0.499
Trend 1990–2011	47.7%	-37.6%	143.0%	538.9%	79.0%	145.1%
Trend 2010–2011	-5.5%	1.7%	-4.1%	-10.2%	-4.4%	-0.2%

As an example Table 50 shows measured and calculated emission data of category 1 A 1 a for the year 2011.

Table 50: Fuel consumption from NFR 1 A 1 a Public Electricity and Heat Production 1990 -2011.

NFR	1 A 1 a	1 A 1 a	1 A 1 a	1 A 1 a	1 A 1 a	1 A 1 a
Fuel		**liquid**	**solid**	**gaseous**	**biomass**	**other**
				[TJ]		
1990	140 537	15 635	61 397	59 463	1 628	2 414
1991	149 411	19 044	67 340	57 554	2 573	2 899
1992	114 727	18 782	39 965	49 495	3 001	3 485
1993	117 575	25 995	30 807	53 892	3 121	3 759
1994	122 531	24 006	32 972	58 336	3 393	3 823
1995	135 179	19 690	45 489	62 067	4 022	3 911
1996	157 793	19 641	47 522	79 744	6 118	4 769
1997	154 767	24 347	50 959	68 417	6 149	4 895
1998	148 844	27 914	35 813	73 526	6 809	4 782
1999	146 880	22 050	37 889	75 731	6 469	4 741
2000	139 094	14 884	49 164	62 357	8 046	4 643
2001	159 571	19 933	59 773	63 197	11 082	5 584
2002	155 000	10 309	56 129	68 721	13 069	6 773
2003	187 668	14 113	70 884	80 810	14 006	7 855
2004	187 102	14 769	69 068	77 334	15 844	10 087
2005	203 551	14 060	61 634	94 162	23 476	10 220
2006	194 258	12 525	60 199	78 266	30 352	12 915
2007	185 641	8 925	54 463	71 378	38 120	12 756
2008	195 963	8 831	47 871	80 877	45 459	12 924
2009	190 125	8 928	32 439	83 705	48 454	16 598
2010	223 475	9 886	41 471	94 781	60 460	16 878
2011	214 803	4 269	45 637	86 628	59 441	18 828
Trend 1990-2011	52.8%	-72.7%	-25.7%	45.7%	3551.3%	679.8%
Trend 2010-2011	-3.9%	-56.8%	10.0%	-8.6%	-1.7%	11.6%

Boilers and gas turbines ≥ 50 MW$_{th}$

This category considers steam boilers and gas turbines with heat recovery. Due to national regulations coal and residual fuel oil operated boilers are mostly eqipped with NO_x controls, flue gas desulphurisation and dust control units. A high share (regarding fuel consumption) of natural gas operated boilers and gas turbines are also equipped with NO_x controls. Emission data of boilers ≥ 50 MW$_{th}$ is consistent with data used for the national report to the Large Combustion Plant Directive 2001/80/EG (UMWELTBUNDESAMT 2006a) except in the case where gap filling was performed. An overview about installed SO_2 and NO_x controls and emission trends are presented in (UMWELTBUNDESAMT 2006a).

Emissions by fuel type are essential for validation and review purposes. If boilers are operated with mixed fuels derivation of fuel specific emissions from measured emissions is not always appropriate. Fuel specific emissions were derived as following:

i Add up fuel consumption and emissons of the boiler size classes ≥ *300 MW_{th}* and ≥ *50 MW_{th} < 300 MW_{th}*. Convert fuel consumption from mass or volume units to TJ by means of average heating values from the energy balance.

ii Derive default emission factors for each fuel type of the "most representative" plants by means of actual flue gas concentration measurements and/or legal emission limits. This work is done by the Umweltbundesamt. The national "default" emission factors are periodically published in reports like (UMWELTBUNDESAMT 2004b).

iii Calculate "default" emissions by fuel consumption and national "default" emission factors.

iv Calculate emission ratio of calculated emissions and measured emissions by boiler size class.

v Calculate emissions by fuel type and boiler size class by multiplying default emissions with emission ratio. Implied emission factors by fuel type may be calculated.

In the approach above different coal types and residuel fuel classifications are considered. Table 51 shows some selected aggregated results for 2005. The ratios of measured to calculated emissions show that the application of a simple Tier 2 approach would introduce a high uncertainty for CO and SO_2. The ratio of 1.13 for NO_x leads to the conclusion that NO_x emission factors are representing legal limits which are not under-run due to high DeNOX operating costs.

Table 51: NFR 1 A 1 a ≥ 50 MW_{th} emission factors, fuel consumption and emissions ratios for the year 2010.

	Fuel consumption [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	SO_2 [kg/TJ]
NFR 1 A 1 a ≥ 50 MWt_h		0.92⁽¹⁾	0.30⁽¹⁾	0.35⁽¹⁾
SNAP 010101		0.95⁽¹⁾	1.06⁽¹⁾	0.40⁽¹⁾
Hard Coal	41 471	50.0	1	57.0
Oil	4 441	26.0	3.0	50.0
Natural gas	74 308	30.0	4.0	NA
Sewage sludge	24	100.0	200.0	130.0
Biomass	1 146	94.0	72.0	11.0
SNAP 010102		0.42⁽¹⁾	2.42⁽¹⁾	NA⁽¹⁾
Natural gas	4 338	30.0	4.0	NA
Waste	3 967	100.0	200.0	130.0
SNAP 010201		7.82¹⁾	16.1⁽¹⁾	11.2⁽¹⁾
Oil	59	100.0	4.0	127.0
Natural gas	1 398	25.0	4.0	NA
SNAP 010202		0.44⁽¹⁾	0.02⁽¹⁾	0.24⁽¹⁾
Oil	2 818	85.0	4.0	126.6
Natural gas	5 909	25.0	4.0	NA
Waste	7 401	48.0	200.0	130.0
Sewage Sludge	684	100.0	200.0	130.0

(1) *Emission ratio of measured emissions divided by calculated emissions.*

Boilers and gas turbines < 50 MW_{th}

Table 52 shows main pollutant emission factors used for calculation of emissions from boilers < 50 MW_{th} for the year 2010. Inceasing biomass consumption of smaller plants is a main source of NO_x emissions from this category in 2010.

Table 52: NFR 1 A 1 a < 50 MW_{th} main pollutant emission factors and fuel consumption for the year 2010.

Fuel	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Light Fuel Oil	71	159.4	10/45$^{(1)}$	0.8	92	2.7
Medium Fuel Oil	0	159.4	15	8.0	196	2.7
Heavy Fuel Oil	2 386	317.4	3/15$^{(1)}$	8.0	50/398$^{(1)}$	2.7
Gasoil	32	65	10	4.8	0.5	2.7
Diesel oil	11	700	15	0.8	18.8	2.7
Liquified Petroleum Gas	7	150	5	0.5	6	1
Natural Gas/power and CHP	6 754	30	4	0.5	NA	1
Natural Gas/district heating	2 074	41	5	0.5	NA	1
Solid Biomass	52 944	94	72	5.0	11	5
Biogas, Sewage Sludge Gas, Landfill Gas	5 609	150	4	0.5	NA	1
Municipal Solid Waste$_{wet}$	3 973	30	200	38.0	130	0.02
Industrial Waste	1 537	100	200	38.0	130	0.02

(1) *Different values for: Electricity & CHP/District heating.*

Sources of emission factors

Sources of NO_x, SO_2, VOC, CO, and TSP emission factors are periodically published reports (BMWA 1990), (BMWA 1996), (BMWA 2003), (UMWELTBUNDESAMT 2004b). These reports provide information about the methodology of emission factor derivation and are structured by SNAP nomenclature. Emisson factors for electricity and heat plants are based on expert judgment by Umweltbundesamt and experts from industry.

The NO_x emission factor for biomass boilers ≤ 50 MW_{th} and municipal solid waste is taken from a national unpublished study (UMWELTBUNDESAMT 2006b). Biomass NO_x EF are derived by means of measurements of 71 boilers which where taken as a representative sample from the approximately 1000 existing biomass boilers in 2005. Municipal waste NO_x EF are derived from plant specific data taken from (BMLFUW 2002b).

NH_3 emission factors for coal, oil and gas are taken from (UMWELTBUNDESAMT 1993). For waste the emission factor of coal is selected. NH_3 emission factors for biomass are taken from (EMEP/CORINAIR 2005, chapter B112) and a value of 5 kg/TJ was selected.

VOC emission factors are divided into NMVOC and CH_4 emission factors as shown in Table 53. The split follows closely (STANZEL et al. 1995).

Table 53: Share of NMVOC emissions in VOC emissions for 1 A 1 a.

	Solid Fossile	Liquid Fossile	Natural Gas	Biomass
Electricity plants	90%	80%	25%	75%
District Heating plants	Hard coal 70% Brown Coal 80%	80%	30%	75%

3.1.3.2 NFR 1 A 1 b Petroleum Refining

In this category emissions from fuel combustion of a single petroleum refining plant are considered. The plant does not have any secondary DeNOX equipment but a certain amount of primary NO_x control has been achieved since 1990 by switching to low NO_x burners (UMWELTBUNDESAMT 2006b). SO_2 reduction is achieved by a regenerative Wellman-Lord process facility (WINDSPERGER & HINTERMEIER 2003). Particulates control is achieved by two electrostatic precipitator (ESP) units. CO emissions were significantly reduced between 1990 and 1991 due to reconstruction of a FCC facility (UMWELTBUNDESAMT 2001a). Since 2007 the plant is equipped with a SNO_X facility which reduces SO_2 by about 65% and NO_X emissions by about 55%.

The Austrian association of mineral oil industry (*Fachverband der Mineralölindustrie*) communicates yearly fuel consumption, SO_2, NO_x, CO, VOC and TSP emissions to the Umweltbundesamt. NMVOC emissions from fuel combustion are reported together with fugitive emissions under category 1 B 2 a. NH_3, heavy metals and POPs emissions are calculated with the simple CORINAIR methodology.

Emissions from this category are presented in the following table.

Table 54: Emissions of SO_2, NO_x, NMVOC, NH_3 and CO as well as PM from NFR 1 A 1 b Petroleum Refining 1990–2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
			[Gg]				[Mg]	
1990	2.25	4.32	IE	0.08	4.65	0.15	0.14	0.12
1991	2.11	4.32	IE	0.08	0.80	NE	NE	NE
1992	2.85	4.19	IE	0.08	0.45	NE	NE	NE
1993	3.42	3.40	IE	0.09	0.46	NE	NE	NE
1994	3.03	3.41	IE	0.10	0.52	NE	NE	NE
1995	2.98	3.38	IE	0.09	0.55	0.10	0.09	0.08
1996	3.49	3.48	IE	0.09	0.44	NE	NE	NE
1997	3.66	3.47	IE	0.09	0.74	NE	NE	NE
1998	3.80	3.36	IE	0.09	0.35	NE	NE	NE
1999	3.55	3.25	IE	0.07	0.46	NE	NE	NE
2000	3.44	3.07	IE	0.08	0.58	0.11	0.10	0.09
2001	3.62	3.30	IE	0.08	0.49	0.12	0.11	0.10
2002	3.69	3.44	IE	0.08	0.72	0.11	0.11	0.09
2003	3.68	3.34	IE	0.08	0.87	0.10	0.10	0.08
2004	3.84	3.44	IE	0.08	0.87	0.11	0.11	0.09
2005	3.35	3.05	IE	0.08	0.42	0.10	0.09	0.08
2006	3.69	3.39	IE	0.09	0.46	0.10	0.09	0.08
2007	3.23	3.05	IE	0.10	0.39	0.10	0.09	0.08
2008	0.85	1.20	IE	0.09	0.39	0.10	0.09	0.08

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
			[Gg]				[Mg]	
2009	0.58	1.05	IE	0.08	0.50	0.10	0.09	0.08
2010	0.62	1.05	IE	0.09	0.31	0.10	0.09	0.08
2011	0.44	0.90	IE	0.09	0.31	0.10	0.09	0.08
Trend 1990–2011	-80.6%	-79.2%		4.5%	-93.3%	-35.3%	-35.3%	-35.3%
Trend 2010–2011	-29.6%	-14.3%		-2.9%	-1.0%	<0.1%	<0.1%	<0.1%

Table 55: Emissions of heavy metals and POPs from NFR 1 A 1 b Petroleum Refining 1990–2011.

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[Mg]	[Mg]	[Mg]	[Mg]	[g]	[kg]
1990	0.0906	0.0069	0.1768	0.0019	0.0190	0.0023
1991	0.1011	0.0077	0.1982	0.0021	0.0187	0.0025
1992	0.0989	0.0075	0.1941	0.0021	0.0186	0.0024
1993	0.1240	0.0095	0.2425	0.0028	0.0203	0.0028
1994	0.1272	0.0097	0.2487	0.0029	0.0202	0.0027
1995	0.1102	0.0085	0.2156	0.0026	0.0187	0.0026
1996	0.1327	0.0100	0.2633	0.0025	0.0201	0.0026
1997	0.1385	0.0105	0.2753	0.0025	0.0201	0.0026
1998	0.1338	0.0101	0.2654	0.0025	0.0199	0.0026
1999	0.1158	0.0087	0.2308	0.0020	0.0158	0.0020
2000	0.1143	0.0086	0.2273	0.0021	0.0165	0.0022
2001	0.1219	0.0092	0.2436	0.0020	0.0170	0.0022
2002	0.1376	0.0103	0.2749	0.0022	0.0167	0.0022
2003	0.1414	0.0106	0.2819	0.0024	0.0168	0.0024
2004	0.1413	0.0111	0.2951	0.0024	0.0166	0.0022
2005	0.1459	0.0099	0.2621	0.0023	0.0177	0.0024
2006	0.1412	0.0114	0.3047	0.0025	0.0200	0.0026
2007	0.1440	0.0116	0.3076	0.0025	0.0208	0.0026
2008	0.1444	0.0103	0.2745	0.0022	0.0198	0.0025
2009	0.1464	0.0097	0.2587	0.0021	0.0193	0.0026
2010	0.1443	0.0100	0.2654	0.0022	0.0205	0.0026
2011	0.1452	0.0099	0.2629	0.0021	0.0199	0.0026
Trend 1990–2011	60.2%	44.0%	48.7%	9.9%	4.6%	8.8%
Trend 2010–2011	0.6%	-1.0%	-1.0%	-1.5%	-3.0%	-3.1%

Table 56: Fuel consumption from NFR 1 A 1 b Petroleum Refining 1990–2011.

NFR	**1 A 1 b**	**1 A 1 b**	**1 A 1 b**	**1 A 1 b**	**1 A 1 b**	**1 A 1 b**
Fuel		**liquid**	**solid**	**gaseous**	**biomass**	**other**
			[TJ]			
1990	38 632	30 750	-	7 882	-	-
1991	38 820	29 446	-	9 375	-	-
1992	38 156	29 626	-	8 530	-	-
1993	42 983	33 105	-	9 878	-	-
1994	42 039	35 111	-	6 928	-	-
1995	39 853	32 248	-	7 606	-	-
1996	41 673	33 291	-	8 383	-	-
1997	41 691	32 955	-	8 736	-	-
1998	41 369	33 049	-	8 320	-	-
1999	32 414	27 272	-	5 142	-	-
2000	34 552	28 195	-	6 356	-	-
2001	34 952	27 571	-	7 381	-	-
2002	34 696	28 228	-	6 468	-	-
2003	36 540	29 617	-	6 923	-	-
2004	34 729	28 614	-	6 115	-	-
2005	39 088	32 229	-	6 859	-	-
2006	42 071	35 371	-	6 699	-	-
2007	43 967	37 765	-	6 203	-	-
2008	41 961	34 692	-	7 269	-	-
2009	42 669	32 276	-	10 393	-	-
2010	42 749	33 190	-	9 559	-	-
2011	41 419	32 357	-	9 062	-	-
Trend 1990-2011	*7.2%*	*5.2%*		*15.0%*		
Trend 2010-2011	*-3.1%*	*-2.5%*		*-5.2%*		

Sources of emission factors

NH_3 emission factors for petroleum products (2.7 kg/TJ) and natural gas (1 g/TJ) are taken from (UMWELTBUNDESAMT 1993).

Facility specific 1990 to 1998 emissions are presented in (UMWELTBUNDESAMT 2000a) and (UMWELTBUNDESAMT 2001a).

3.1.3.3 NFR 1 A 1 c Manufacture of Solid fuels and Other Energy Industries

This category includes emissions from natural gas combustion in the oil and gas extraction sector, natural gas raffination, natural gas compressors for natural gas storage systems as well as own energy use of gas works which closed in 1995.

Furthermore PM emissions of charcoal kilns are included in this category.

Emissions from final energy consumption of coal mines are included in category 1 A 2 f. Emissions from coke ovens are included in category 1 A 2 a.

Emissions from this category are presented in the following table.

Table 57: Emissions of SO_2, NO_x, NMVOC, NH_3 and CO as well as PM from NFR 1 A 1 c Manufacture of Solid fuels and Other Energy Industries 1990–2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
			[Gg]				[Mg]	
1990	0.00037	1.373	0.005	0.009	0.092	0.074	0.073	0.073
1991	0.00024	1.482	0.005	0.010	0.099	NE	NE	NE
1992	0.00000	1.413	0.005	0.009	0.094	NE	NE	NE
1993	0.00001	1.148	0.004	0.008	0.077	NE	NE	NE
1994	0.00001	1.225	0.004	0.008	0.082	NE	NE	NE
1995	0.00004	1.654	0.006	0.011	0.110	0.075	0.074	0.073
1996	NA	0.706	0.002	0.005	0.047	NE	NE	NE
1997	NA	0.751	0.003	0.005	0.050	NE	NE	NE
1998	NA	0.953	0.003	0.006	0.064	NE	NE	NE
1999	NA	1.087	0.004	0.007	0.072	NE	NE	NE
2000	NA	0.902	0.003	0.006	0.060	0.072	0.072	0.072
2001	NA	0.905	0.003	0.006	0.060	0.072	0.072	0.072
2002	NA	0.937	0.003	0.006	0.062	0.072	0.072	0.072
2003	NA	1.593	0.005	0.011	0.106	0.075	0.074	0.073
2004	NA	2.063	0.007	0.014	0.138	0.076	0.076	0.075
2005	NA	1.903	0.006	0.013	0.127	0.083	0.082	0.081
2006	NA	1.762	0.006	0.012	0.117	0.090	0.090	0.089
2007	NA	1.536	0.005	0.010	0.102	0.085	0.084	0.084
2008	NA	1.429	0.005	0.010	0.095	0.092	0.091	0.090
2009	NA	1.621	0.005	0.011	0.108	0.100	0.100	0.099
2010	NA	1.345	0.004	0.009	0.090	0.087	0.086	0.085
2011	NA	1.627	0.005	0.011	0.108	0.084	0.083	0.083
Trend 1990–2011	*-100.0%*	*18.5%*	*17.9%*	*16.6%*	*17.9%*	*13.6%*	*13.6%*	*13.6%*
Trend 2010–2011		*20.9%*	*20.9%*	*20.9%*	*20.9%*	*-2.9%*	*-3.0%*	*-3.2%*

Table 58: Emissions of heavy metals and POPs from NFR 1 A 1 c Manufacture of Solid fuels and Other Energy Industries 1990–2011.

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[Mg]	[Mg]	[Mg]	[Mg]	[g]	[kg]
1990	NA	NA	NA	0.0000	0.0019	0.0004
1991	NA	NA	NA	0.0000	0.0020	0.0004
1992	NA	NA	NA	0.0000	0.0019	0.0004
1993	NA	NA	NA	0.0000	0.0015	0.0003
1994	NA	NA	NA	0.0000	0.0016	0.0003
1995	NA	NA	NA	0.0000	0.0022	0.0004

Year	Cd	Hg	Pb	PAH	Diox	HCB
1996	NA	NA	NA	NA	0.0009	0.0002
1997	NA	NA	NA	NA	0.0010	0.0002
1998	NA	NA	NA	NA	0.0013	0.0003
1999	NA	NA	NA	NA	0.0014	0.0003
2000	NA	NA	NA	NA	0.0012	0.0002
2001	NA	NA	NA	NA	0.0012	0.0002
2002	NA	NA	NA	NA	0.0012	0.0002
2003	NA	NA	NA	NA	0.0021	0.0004
2004	NA	NA	NA	NA	0.0028	0.0006
2005	NA	NA	NA	NA	0.0025	0.0005
2006	NA	NA	NA	NA	0.0023	0.0005
2007	NA	NA	NA	NA	0.0020	0.0004
2008	NA	NA	NA	NA	0.0019	0.0004
2009	NA	NA	NA	NA	0.0022	0.0004
2010	NA	NA	NA	NA	0.0018	0.0004
2011	NA	NA	NA	NA	0.0022	0.0004
Trend 1990–2011				*-100.0%*	*12.3%*	*16.0%*
Trend 2010–2011					*20.9%*	*20.9%*

Fuel consumption is taken from the national energy balance. Emissions are calculated with the simple CORINAIR methodology.

Table 59: Fuel consumption from NFR 1 A 1 c Manufacture of Solid fuels and Other Energy Industries 1990–2011.

NFR	**1 A 1 c**	**1 A 1 c**	**1 A 1 c**
Fuel		**Liquid**	**Gaseous**
		[TJ]	
1990	9 196	62	9 135
1991	9 909	40	9 869
1992	9 423	0	9 423
1993	7 657	2	7 655
1994	8 168	1	8 166
1995	11 032	7	11 025
1996	4 706	0	4 706
1997	5 003	0	5 003
1998	6 355	0	6 355
1999	7 249	0	7 249
2000	6 013	0	6 013
2001	6 030	0	6 030
2002	6 249	0	6 249
2003	10 619	0	10 619
2004	13 754	0	13 754

NFR	1 A 1 c	1 A 1 c	1 A 1 c
Fuel		Liquid	Gaseous
		[TJ]	
2005	12 686	0	12 686
2006	11 744	0	11 744
2007	10 241	0	10 241
2008	9 526	0	9 526
2009	10 805	0	10 805
2010	8 966	0	8 966
2011	10 844	0	10 844
Trend 1990-2011	17.9%	-100.0%	18.7%
Trend 2010-2011	20.9%		20.9%

Emission factors and activity data 2010

Table 60 summarizes the selected emission factors for main pollutants and activity data for the year 2010. It is assumed that emissions are uncontrolled.

Table 60: NFR 1 A 1 c main pollutant emission factors and fuel consumption for the year 2010.

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors(1)	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Natural Gas/Oil gas extraction and Gasworks	(BMWA 1990)	9 526	150.0	10.0	0.5	NA	1.0
Residual fuel oil/ Gasworks	(BMWA 1996)	0(2)	235.0	15.0	8.0	398.0	2.7
Liquid petroleum gas/Gasworks	(BMWA 1990)	0(2)	40.0	10.0	0.5	6.0	1.0

(1) *Default emission factors for industry are selected*

(2) *Gasworks closed in 1995*

NH_3 emission factors are taken from (UMWELTBUNDESAMT 1993).

PM emissions from charcoal production

It is assumed (WINIWARTER et al. 2007) that charcoal is produced in traditionally kilns by approximately 20 producers. Assuming 10 charges per producer and year each of 50 m^3 wood input , assuming an output of 200 kg of charcoal from 1 000 kg of wood input and assuming a density of 350 kg/m^3 wood leads to an estimated activity of 1 000 t charcoal per year which is 31 TJ (net calorific value 31 MJ/kg charcoal). Applying an emission factor of 2.2 kg TSP/GJ charcoal which is similar to brown coal stoker fired furnaces this leads to an emission of approx. 70 t TSP per year. Furthermore it is assumed that 100% of particles are PM2.5.

Emission factors for heavy metals, POPs and PM used in NFR 1 A 1

In the following emission factors for heavy metals, POPs and PM which are used in NFR 1 A 1 are described and references are given.

Emission factors for heavy metals used in NFR 1 A 1

Coal

Values were taken from the CORINAIR Guidebook (1999), Page B111-58, Table 31:

For 1985, two thirds of the values for "DBB, Dust Control" were used (from the ranges given in the guidebook the mean value was used). For 1995, the value for "DBB, Dust Control + FGD" was used, as in these 10 years the existing dust controls were supplemented with flue gas desulphurisation. For the years in between the values were linearly interpolated.

The net calorific value used to convert values given in [g/Mg fuel] to [g/MJ fuel] was 28 MJ/kg for hard coal and 10.9 MJ/kg for brown coal.

Due to the legal framework most coal fired power plants were already equipped with dust control and flue gas desulphurisation in 1995, and no substantial further improvements were made since then. Thus the emission factor for 1995 was used for the years onwards.

The cadmium emission factor of brown coal is derived from a flue gas concentration of 6 µg/m^3 (UMWELTBUNDESAMT 2003b).

Fuel oil

The emission factors base on the heavy metal content of oil products of the only Austrian refinery that were analysed in 2001 (see Table 61). It is assumed that imported oil products have a similar metal content.

Table 61: Heavy Metal Contents of Fuel Oils in Austria.

[mg/kg]	Cadmium	Mercury	Lead
Heating Oil	< 0.01	< 0.003	< 0.01
Light fuel oil	< 0.01	< 0.003	< 0.01
Heavy fuel oil (1%S)	0.04	< 0.003	< 0.01

Only for heavy fuel oil a value for the heavy metal content was quantifiable, for lighter oil products the heavy metal content was below the detection limit. As the heavy metal content depends on the share of residues in the oil product the emission factor of medium fuel oil was assumed to be half the value of heavy fuel oil. For light fuel oil and heating and other gas oil one fifth and one tenth respectively of the detection limit was used.

As legal measures ban the use of heavy fuel oil without dust abatement techniques and the emission limits were lower over the years it was assumed that the emission factor decreased from 1985–1995 by 50%, except for Mercury where dust abatement techniques do not effect emissions as efficiently as Mercury is mainly not dust-bound.

The emission factors for "other oil products" (which is only used in the refinery) are based on the following assumption: the share of Cd and Pb in crude oil is about 1% and 2%, respectively. The share of these HM in particulate emissions of the refinery was estimated to be a fifth of the share in crude oil, that results in a share of 0.2% and 0.4% of dust emissions from the refinery. Based on a TSP emission factor of about 5.7 g/GJ, the resulting emission factors for Cd and Pb are 10 mg/GJ and 20 mg/GJ.

For Mercury 10 times the EF for heavy fuel oil for category *1 A 1 a* was used.

For 1985 twice the value as for 1990 was used.

Other Fuels

For fuel wood the value from (OBERNBERGER 1995) for plants > 4 MW was used for 1985 and 1990. For 1995 and for wood waste for the whole time series the value taken from a personal information about emission factors for wood waste from the author was used.

For plants < 50 MW the emission factor for industrial waste is based on measurements of Austrian plants (FTU 2000).

The emission factors for the years 1985–1995 for municipal waste and sewage sludge base on regular measurements at Austrian facilities (MA22 1998). For industrial waste for plants > 50 MW emission factors were base on (EPA 1998, CORINAIR 1997, EPA 1997, EPA 1993, WINIWARTER 1993, ORTHOFER 1996); improvements in emission control have been considered.

The emission factors for waste (municipal and industrial waste and sewage sludge) for plants > 50 MW for 2004 were taken from (BMLFUW 2002b):

Table 62: Cd emission factors for Sector 1 A 1 Energy Industries.

Cadmium EF [mg/GJ]	1985	1990	1995	2010
Coal				
102A Hard coal	0.1548	0.1140	0.073	0.073
105A Brown coal	2.13 (all years)			
Oil				
204A Heating and other gas oil 2050 Diesel	0.02 (all years)			
203B Light fuel oil	0.05 (all years)			
203C Medium fuel oil	0.5 (all years)			
203D Heavy fuel oil	1.0	0.75	0.5	0.5
110A Petrol coke 224A Other oil products	20	10	10	10
Other Fuels				
111A Fuel wood 116A Wood waste	6.1	6.1	2.5	2.5
115A Industrial waste (< 50MW)	7 (all years)			

The following table presents Cd emission factors of several waste categories. Emission factors 2006 are derived from actual measurements (UMWELTBUNDESAMT 2007).

Table 63: Cd emission factors for waste for Sector 1 A 1 Energy Industries.

Cadmium EF [mg/t Waste]	1985	1990	1995	2010
114B Municipal waste	2 580	71	12	11
115A Industrial waste (> 50 MW)	720	510	30	4.5
118A Sewage sludge	–	235	19	5.2

Table 64: Hg emission factors for Sector 1 A 1 Energy Industries.

Mercury EF [mg/GJ]	1985	1990	1995	2010
Coal				
102A Hard coal	2.98	2.38	1.8	1.8
105A Brown coal	7.65	6.12	4.6	4.6

Mercury EF [mg/GJ]	**1985**	**1990**	**1995**	**2010**
Oil				
204A Heating and other gas oil 2050 Diesel		0.007 (all years)		
203B Light fuel oil		0.015 (all years)		
203C Medium fuel oil		0.04 (all years)		
203D Heavy fuel oil		0.075 (all years)		
110A Petrol coke 224A Other oil products		0.75 (all years)		
Other Fuels				
111A Fuel wood		1.9 (all years)		
116A Wood waste (> 50 MW)		1.9 (all years)		
115A Industrial waste (< 50 MW)		2.0 (all years)		

The following table presents Hg emission factors of several waste categories. Emission factors 2006 are derived from actual measurements (UMWELTBUNDESAMT 2007).

Table 65: Hg emission factors for waste for Sector 1 A 1 Energy Industries.

Mercury EF [mg/t Waste]	**1985**	**1990**	**1995**	**2010**
114B Municipal waste	1 800	299	120	25.2
115A Industrial waste (> 50 MW)	100	112	49	15.5
118A Sewage sludge	–	55	9	9

Table 66: Pb emission factors for Sector 1 A 1 Energy Industries.

Lead EF [mg/GJ]	**1985**	**1990**	**1995**	**2010**
Coal				
102A Hard coal	13.33	11.19	9.1	9.1
105A Brown coal	1.93	1.44	0.96	0.96
Oil				
204A Heating and other gas oil 2050 Diesel			0.02 (all years)	
203B Light fuel oil			0.05 (all years)	
203C Medium fuel oil			0.12 (all years)	
203D Heavy fuel oil	0.25	0.19	0.13	0.13
110A Petrol coke 224A Other oil products			20 (all years)	
Other Fuels				
111A Fuel wood	26.3	26.3	21.15	21.15
116A Wood waste: Public Power [0101]			21 (all years)	
116A Wood waste: District Heating [0102]			50 (all years)	
115A Industrial waste (< 50 MW)			50 (all years)	

The following table presents Hg emission factors of several waste categories. Emission factors 2006 are derived from actual measurements (UMWELTBUNDESAMT 2007).

Table 67: Pb emission factors for waste for Sector 1 A 1 Energy Industries.

Lead EF [mg/t Waste]	1985	1990	1995	2010
114B Municipal waste	30 000	1 170	150	36
115A Industrial waste (> 50 MW)	8 300	2 400	10	10
118A Sewage sludge	–	730	6	6

Emission factors for POPs used in NFR 1 A 1

Fossil fuels

The dioxin (PCDD/F) emission factor for coal and gas were taken from (WURST & HÜBNER 1997), for fuel oil the value given in the same study and new measurements were considered (FTU 2000).

The HCB emission factor for coal was taken from (BAILY 2001).

The PAK emission factors are based on results from (UBA BERLIN 1998), (BAAS et al. 1995), (ORTHOFER & VESSELY 1990) and measurements by FTU.

Other fuels

The dioxin (PCDD/F) emission factor for wood bases on measurements at Austrian plants > 1 MW (FTU 2000).

The PAK emission factors are based on results from (UBA BERLIN 1998) and (BAAS et al. 1995).

Gasworks

Default national emission factors of industrial boilers were selected. For *224A Other Oil Products* the emission factors of *303A LPG* were selected.

Table 68: POP emission factors for Sector 1 A 1 Energy Industries.

EF	PCDD/F [µg/GJ]	HCB [µg/GJ]	PAK4 [mg/GJ]
Coal			
Coal (102A, 105A, 106A)	0.0015	0.46	0.0012
Fuel Oil			
Fuel Oil (203B, 203C, 203D, 204A) exc. Gasworks, 110A Petrol coke	0.0004	0.08	0.16
203D Heavy fuel oil in gasworks	0.009	0.12	0.24
224A Other oil products in gasworks	0.0017	0.14	0.011
308A Refinery gas	0.0006	0.04	NA
Gas			
301A, 303A Natural gas and LPG exc. SNAP 010202, 010301	0.0002	0.04	NA
301A, 303A Natural gas and LPG, SNAP 010202, 010301	0.0004	0.08	NA
Other Fuels			
115A Industrial waste/unspecified	0.024	14.5	0.17

Biomass			
111A Wood (> 1 MW) 116A Wood waste (> 1 MW)	0.01	2.0	0.2
111A Wood (< 1 MW) 116A Wood waste (< 1 MW)	0.14	28.0	2.4
116A Wood waste/Straw	0.12	24.0	3.7
309A, 309B, 310A Gaseous biofuels	0.0006	0.072	0.032

Waste emissions factors are expressed as per ton of dry substance and derived from plant specific measurements (UMWELTBUNDESAMT 2002, 2007). Comma separated values indicate plant specific emissions factors.

Table 69: POP emission factors for Sector 1 A 1 Energy Industries.

EF	PCDD/F [µg/t]	HCB [µg/t]	PAK4 [mg/t]
114B Municipal Waste	0.09	247.0	0.7; 0.13
115A Industrial waste	0.21	126.0	0.16
118A Sewage Sludge	0.09	20.0	0.09

Emission factors for PM used in NFR 1 A 1

As already described in Chapter 1.3 the emission inventories of PM for different years were prepared by contractors and incorporated into the inventory system afterwards.

Large point sources (LPS)

In a first step large point sources (LPS) are considered. The UMWELTBUNDESAMT is operating a database to store plant specific data, called „*Dampfkesseldatenbank"* (DKDB) which includes data on fuel consumption, NO_x, SO_x, CO and PM emissions from boilers with a thermal capacity greater than 3 MW for all years from 1990 onwards. These data are used to generate a sectoral split of the categories *Public Power* and *District Heating*, with further distinction between the two categories ≥ *300 MW* and ≥ *50 MW to 300 MW* of thermal capacity. Currently 56 boilers are considered with this approach.

The fuel consumption of all considered point sources is subtracted from the total consumption of this category which is taken from the energy balance. The other combustion plants are considered as area source.

For point sources ≥ 50 MW plant specific emission and activity data from the DKDB were used. The 'implied emission factors', which are calculated by division of emissions by activity data, are given in Table 70.

Emission factors from 2000 onwards for the fuel type **wood waste** were taken from (UMWELTBUNDESAMT 2006a).

The shares of PM10 and PM2.5 were taken from (WINIWARTER et al. 2001).

Table 70: PM implied emission factors (IEF) for LPS in NFR 1 A1 Energy Industries.

	TSP IEF [g/GJ]				%PM10	%PM2.5
	1990	1995	2000	2010	[%]	[%]
Public Power (0101)$^{(1)}$	5.51	3.34	2.74	1.67	95	80
District Heating (0102) $^{(1)}$	3.89	1.41	0.75	0.58	95	80
Petroleum Refining (010301)$^{(2)}$	3,4	2,8	3.5	2.3	95	80
Wood waste (116A)	55	55	22	22	90	75

(1) *Used fuels are 102A, 105A, 111A, 115A, 118A, 203B, 203C, 203D, 301A*

(2) *Used fuels: Refinery gas (308A), FCC coke (110A), Residual Fuel Oil (203D), LPG (303A), Other oil products (224A) and Natural gas (301A)*

Area sources

In a second step the emissions of the **area source** are calculated. Emissions of plants < 50 MW are calculated by multiplying emission factors with the corresponding activity.

Coal and gas

The emission factors for **coal** and **gas** were taken from (WINIWARTER et al. 2001) and are valid for the whole time series.

Oil

The emission factor for **high-sulphur fuel** (203D) **medium-sulphur fuel** (203C) and **low-sulphur fuel** (203B) base on an analysis of Austrian combustion plants regarding limit values (TSP: 70 mg/Nm³, 60 mg/Nm³ and 50 mg/Nm³) (UMWELTBUNDESAMT 2006a), these values were used for all years.

The emission factor for **heating and other gas oil** (204A) was taken from (WINIWARTER et al. 2001) and used for all years. [106]

For diesel the emission factors for heavy duty vehicles and locomotives as described in Chapter 3.3 were used.

Other Fuels

Emission factors for **wood** and **wood waste** (111A and 116A)**, MSW renewable, MSW non-renewable** and **industrial waste** (114B and 115A) and **low-sulphur fuel** (203B) for the years 1990 and 1995 were taken from (WINIWARTER et al. 2001), for the years afterwards an updated value from (UMWELTBUNDESAMT 2006a) has been used.

The emission factor for **biogas, sewage sludge gas** and **landfill gas** (309B and 310A) were taken from (WINIWARTER et al. 2001) and used for all years.

The shares of PM10 and PM2.5 were taken from (WINIWARTER et al. 2001).

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[106] a of central heating plants in houses (Hauszentralheizung – HZH)

Table 71: PM emission factors for combustion plants (< 50 MW) in NFR 1 A 1.

	TSP Emission Factors [g/GJ]				PM10	PM2.5
	1990	1995	2000	2010	[%]	[%]
Gas						
301A and 303A	0.50				90	75
Coal						
102A	45.00				90	75
105A and 106 A	50.00				90	75
Oil						
203B	16.00				90	75
203D	22.00				90	80
204A	1.00				90	80
224A	0.50				90	75
2050	50.00				100	100
Other Fuels						
111A and 116A	55.00	55.00	22.00	22.00	90	75
114B and 115 A	9.00	9.00	1.00	1.00	95	80
309B and 310A	0.50				90	75

3.1.4 NFR 1 A 2 Manufacturing Industry and Combustion

NFR Category *1 A 2 Manufacturing Industries and Construction* comprises emissions from fuel combustion in the sub categories

- iron and steel (NFR 1 A 2 a),
- non-ferrous metals (NFR 1 A 2 b),
- chemicals (NFR 1 A 2 c),
- pulp, paper and print (NFR 1 A 2 d),
- food processing, beverages and tobacco (NFR 1 A 2 e),
- other (NFR 1 A 2 f)
  - other-mobile in industry (NFR 1 A 2 f 1)[107]
  - other-stationary in industry (NFR 1 A 2 f 2).

3.1.4.1 General Methodology

Table 72 gives an overview of methodologies and data sources of sub category *1 A 2 Manufacturing Industry and Combustion*. Reported/Measured emission data is not always taken one-to-one in cases that reported fuel consumption is not in line with data from energy balance. However, in these cases data is used for emission factor derivation. For 2005 to 2008 activity data from the emission trading system (ETS) has been considered for validation of the energy statistics and ETS activity data has been used for a sectoral breakdown of category 1 A 2 f.

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[107] methodologies for mobile sources are described in Chapter 3.3

Table 72: Overview of 1 A 2 methodologies for main pollutants.

		Activity data	Reported/Measured emissions	Emission factors
1 A 2 a	Iron and Steel – Integrated Plants (2 units)	Reported by plant operator (yearly).	Reported by plant operator: SO_2, NO_x, CO, NMVOC, TSP, (yearly).	NH_3: National study
1 A 2 a	Iron and Steel – other	Energy balance 2005–2010: ETS data.		All pollutants: National studies
1 A 2 b	Non Ferrous Metals	Energy balance 2005–2010: ETS data.		All pollutants: National studies
1 A 2 c	Chemicals	Energy balance 2005–2010: ETS data.		All pollutants: National studies
1 A 2 d	Pulp, Paper and Print	Energy balance 2005–2010: ETS data.	Reported by Industry Association: SO_2, NO_x, CO, NMVOC, TSP (yearly).	NH_3: National study
1 A 2 e	Food Processing, Beverages and Tobacco	Energy balance 2005–2010: ETS data.		All pollutants: National studies
1 A 2 f	Cement Clinker Production	National Studies 2005–2010: ETS data.	Reported by Industry Association: SO_2, NO_x, CO, NMVOC, TSP, Heavy Metals (yearly).	NH_3: National study
1 A 2 f	Glass Production	Association of Glass Industry 2005–2010: ETS data.	Direct information from industry association: NO_x,SO_2.	CO, NMVOC, NH_3: National studies
1 A 2 f	Lime Production	Energy balance 2005–2010: ETS data.		All pollutants: National studies
1 A 2 f	Bricks and Tiles Production	Association of Bricks and Tiles Industry 2005–2010: ETS data.		All pollutants: National studies
1 A 2 f	Other	Energy balance 2005–2010: ETS data.		All pollutants: National studies

3.1.4.2 NFR 1 A 2 a Iron and Steel

In this category mainly two integrated iron and steel plants with a total capacity of 5.5 mio t crude steel per year are considered. Facilities relevant for air emissions are blast furnaces, coke ovens, iron ore sinter plants, LD converters, rolling mills, scrap preheating, collieries and other metal processing. According to the SNAP and NFR nomenclatures this activities have to be reported to several sub categories. In case of the Austrian inventory emissions from above mentioned activities are reported in sub categories *1 A 2 a* and *2 C.* Overall heavy metals, POPs and PM emissions are included in category *2 C* (SNAP 0402). Emissions from fuel combustion in other steel manufacturing industries are considered in category *1 A 2 a* too.

Emissions from this category are presented in the following table.

Table 73: Emissions of SO_2, NO_x, NMVOC, NH_3 and CO as well as PM from NFR 1 A 2 a Iron and Steel 1990 – 2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
			[Gg]				[Mg]	
1990	6.73	5.41	0.08	0.03	210.72	0.057	0.051	0.043
1991	5.35	5.44	0.06	0.03	185.44	NE	NE	NE
1992	3.48	4.51	0.05	0.03	226.94	NE	NE	NE
1993	3.94	4.90	0.06	0.03	237.42	NE	NE	NE
1994	4.24	4.57	0.07	0.03	250.64	NE	NE	NE

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
	[Gg]					[Mg]		
1995	4.22	4.86	0.07	0.03	182.16	0.076	0.068	0.057
1996	4.76	4.75	0.07	0.03	206.70	NE	NE	NE
1997	4.75	4.90	0.08	0.04	211.64	NE	NE	NE
1998	4.70	4.95	0.08	0.04	197.84	NE	NE	NE
1999	4.73	4.69	0.08	0.04	176.62	NE	NE	NE
2000	4.46	4.66	0.10	0.05	164.53	0.065	0.059	0.049
2001	4.79	4.37	0.10	0.05	140.83	0.042	0.038	0.031
2002	4.90	4.67	0.10	0.04	134.42	0.030	0.027	0.023
2003	5.04	4.66	0.23	0.04	147.24	0.024	0.021	0.018
2004	4.71	4.40	0.26	0.04	153.18	0.033	0.029	0.024
2005	5.31	5.13	0.30	0.05	138.27	0.063	0.057	0.047
2006	5.77	5.24	0.33	0.05	148.01	0.063	0.057	0.048
2007	5.62	5.12	0.31	0.05	138.87	0.032	0.029	0.024
2008	5.29	5.09	0.28	0.05	124.71	0.085	0.076	0.063
2009	4.97	4.68	0.28	0.04	117.05	0.185	0.166	0.139
2010	4.92	4.42	0.25	0.04	107.83	0.030	0.027	0.023
2011	5.10	4.32	0.27	0.04	120.85	0.028	0.026	0.021
Trend 1990–2011	-24.2%	-20.1%	259.1%	35.1%	-42.6%	-50.2%	-50.2%	-50.2%
Trend 2010–2011	3.5%	-2.2%	10.0%	-12.1%	12.1%	-6.1%	-6.1%	-6.1%

Table 74: Emissions of heavy metals and POPs from NFR 1 A 2 a Iron and Steel 1990–2011.

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[Mg]	[Mg]	[Mg]	[Mg]	[g]	[kg]
1990	0.0061	0.0003	0.2649	0.0005	0.0336	0.0062
1991	0.0056	0.0001	0.2425	0.0003	0.0280	0.0054
1992	0.0045	0.0000	0.1993	0.0002	0.0230	0.0044
1993	0.0038	0.0006	0.1581	0.0008	0.0326	0.0050
1994	0.0039	0.0006	0.1650	0.0008	0.0329	0.0051
1995	0.0039	0.0006	0.1675	0.0009	0.0354	0.0054
1996	0.0039	0.0005	0.1581	0.0009	0.0360	0.0055
1997	0.0036	0.0005	0.1609	0.0008	0.0367	0.0055
1998	0.0039	0.0004	0.1791	0.0006	0.0332	0.0053
1999	0.0038	0.0002	0.1707	0.0004	0.0256	0.0044
2000	0.0042	0.0002	0.1798	0.0005	0.0276	0.0048
2001	0.0040	0.0002	0.1807	0.0004	0.0265	0.0046
2002	0.0037	0.0002	0.1702	0.0004	0.0264	0.0045
2003	0.0036	0.0002	0.1652	0.0003	0.0256	0.0044
2004	0.0040	0.0002	0.1823	0.0004	0.0266	0.0047
2005	0.0042	0.0006	0.1856	0.0010	0.0402	0.0061
2006	0.0044	0.0007	0.1962	0.0010	0.0432	0.0066

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[Mg]	[Mg]	[Mg]	[Mg]	[g]	[kg]
2007	0.0045	0.0005	0.2105	0.0007	0.0378	0.0061
2008	0.0049	0.0003	0.2088	0.0006	0.0318	0.0055
2009	0.0041	0.0004	0.1309	0.0010	0.0259	0.0042
2010	0.0035	0.0002	0.1578	0.0004	0.0245	0.0042
2011	0.0036	0.0002	0.1627	0.0004	0.0254	0.0043
Trend 1990–2011	-41.9%	-19.1%	-38.6%	-18.6%	-24.6%	-30.1%
Trend 2010–2011	2.4%	1.4%	3.1%	-1.3%	3.6%	3.4%

Activity data

Fuel consumption is taken from (IEA JQ 2012).

Table 75: Fuel consumption from NFR 1 A 2 a Iron and Steel 1990–2011.

NFR	1 A 2 a	1 A 2 a	1 A 2 a	1 A 2 a	1 A 2 a	1 A 2 a
Fuel		liquid	solid	gaseous	biomass	other
				[TJ]		
1990	55 628	5 786	38 113	11 730	0	0
1991	52 309	5 789	34 405	12 115	0	0
1992	45 275	5 609	28 135	11 531	0	0
1993	47 745	5 906	30 806	11 033	0	0
1994	50 762	6 229	32 286	12 247	0	0
1995	54 714	7 166	33 877	13 672	0	0
1996	54 990	6 046	32 100	16 824	20	0
1997	62 472	6 744	36 162	19 565	0	0
1998	56 745	8 658	28 856	19 231	0	0
1999	57 645	8 381	31 078	18 186	0	0
2000	61 242	10 544	33 047	17 651	0	0
2001	61 473	11 353	32 140	17 981	0	0
2002	64 473	8 441	37 354	18 679	0	0
2003	65 191	7 138	39 646	18 407	0	0
2004	68 807	9 022	39 456	20 329	0	0
2005	75 602	10 169	44 229	21 204	0	0
2006	74 207	9 847	43 138	21 222	0	0
2007	72 397	11 044	41 715	19 634	3	0
2008	71 699	10 201	42 628	18 864	5	0

NFR	1 A 2 a	1 A 2 a	1 A 2 a	1 A 2 a	1 A 2 a	1 A 2 a
Fuel		**liquid**	**solid**	**gaseous**	**biomass**	**other**
				[TJ]		
2009	60 186	7 570	33 690	18 921	4	0
2010	67 372	8 666	40 528	18 176	2	0
2011	67 244	5 699	40 461	21 082	2	0
Trend 1990-2011	*20.9%*	*-1.5%*	*6.2%*	*79.7%*		
Trend 2010-2011	*-0.2%*	*-34.2%*	*-0.2%*	*16.0%*	*-10.4%*	

Integrated steelworks (two units)

Two companies report their yearly NO_x, SO_2, NMVOC, CO and PM emissions to the Umweltbundesamt. Environmental reports are availabe on the web at www.emas.gv.at under EMAS register-Nr. 221 and 216 which partly include data on air emissions. During the last years parts of the plants where reconstructed and equipped with PM emission controls which has also led to lower heavy metal and POP emissions. Reduction of SO_2 and NO_x emissions of in-plant power stations was achieved by switching from coal and residual fuel oil to natural gas.

Table 76: Emission controls of integrated iron & steel plants.

	Facility	Controlled emissions
Plant 1 1,3 mio t/a crude steel	Iron ore sinter plant:	PM: electro filter, fabric filter
	Cast house/pig iron recasting	PM
	LD converter	PM: electro filter
	Ladle furnace	PM: electro filter
Plant 2: 3,8 mio t/a crude steel	Iron ore sinter plant: 2 mio t/a sinter	PM: "AIRFINE" wet scrubber
	Coke oven: 1,9 mio t/a coke	Coke transport and quenching: PM
	Cast house	PM
	LD converter	PM
	Rolling mill	PM

Other fuel combustion

Fuel combustion in other iron and steel manufacturing industry is calculated by the simple CORINAIR methodology. Activity data is taken from energy balance. The following tables summarize the selected emission factors for the main pollutants and activity data for the year 2010. It is assumed that emissions are uncontrolled.

Table 77:NFR 1 A 2 a main pollutant emission factors and fuel consumption for the year 2010.

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Hard coal	(BMWA 1990) (1)	19	250.0	150.0	15.0	600.0	0.01
Coke oven coke	(BMWA 1990) (1)	87	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) (1)	33	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	360	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) (2)	2	65.0	15.0	4.8	45.0	2.70
Kerosene	(BMWA 1996) (3)	1	118.0	15.0	4.8	92.0	2.70
Natural gas	(BMWA 1996) (1)	3 773	41.0	5.0	0.5	NA	1.00
LPG	(BMWA 1996) (4)	13	41.0	5.0	0.5	6.0(6)	1.00

(1) *Default emission factors for industry*

(2) *Default emission factors for district heating plants*

(3) *Upper values from residual fuel oil < 1% S and heating oil*

(4) *Values for natural gas are selected*

(5) *Values for bark are selected*

(6) *From (LEUTGÖB et al. 2003)*

NH_3 emission factors are taken from (UMWELTBUNDESAMT 1993). PM, HM and POP emission factors are described in a separate section below.

3.1.4.3 NFR 1 A 2 b Non-ferrous Metals

This category enfolds emissions from fuel combustion in non ferrous metals industry including heavy metal and POPs emissions from melting of products. Fuel consumption activity data is taken from the energy balance.

Emissions from this category are presented in the following tables.

Table 78: Emissions of SO_2, NO_x, NMVOC, NH_3 and CO as well as PM from NFR 1 A 2 b Non-ferrous Metals 1990–2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
			[Gg]				[Mg]	
1990	0.148	0.255	0.003	0.002	0.047	0.013	0.011	0.009
1991	0.132	0.209	0.003	0.002	0.039	NE	NE	NE
1992	0.065	0.193	0.002	0.002	0.026	NE	NE	NE
1993	0.122	0.217	0.003	0.003	0.044	NE	NE	NE
1994	0.116	0.289	0.004	0.005	0.047	NE	NE	NE
1995	0.092	0.225	0.003	0.005	0.037	0.010	0.009	0.008
1996	0.131	0.182	0.003	0.003	0.039	NE	NE	NE
1997	0.184	0.241	0.004	0.005	0.049	NE	NE	NE
1998	0.160	0.218	0.004	0.004	0.043	NE	NE	NE
1999	0.166	0.201	0.004	0.004	0.050	NE	NE	NE

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
			[Gg]				[Mg]	
2000	0.157	0.201	0.004	0.004	0.045	0.017	0.015	0.012
2001	0.101	0.191	0.004	0.004	0.035	0.010	0.009	0.008
2002	0.162	0.213	0.005	0.004	0.044	0.020	0.018	0.015
2003	0.128	0.205	0.004	0.004	0.043	0.013	0.012	0.010
2004	0.109	0.202	0.003	0.004	0.043	0.010	0.009	0.007
2005	0.093	0.197	0.003	0.004	0.039	0.009	0.008	0.007
2006	0.088	0.199	0.003	0.004	0.039	0.008	0.008	0.006
2007	0.094	0.221	0.003	0.005	0.043	0.010	0.009	0.007
2008	0.093	0.223	0.003	0.005	0.043	0.009	0.009	0.007
2009	0.104	0.237	0.004	0.005	0.047	0.011	0.010	0.008
2010	0.082	0.211	0.003	0.004	0.039	0.009	0.008	0.007
2011	0.078	0.207	0.003	0.004	0.040	0.008	0.007	0.006
Trend 1990–2011	-47.2%	-18.6%	11.1%	105.6%	-15.4%	-33.5%	-33.5%	-33.5%
Trend 2010–2011	-4.7%	-1.6%	-0.6%	-2.0%	2.7%	-5.1%	-5.1%	-5.1%

Table 79: Emissions of heavy metals and POPs from NFR 1 A 2 b Non-ferrous Metals 1990–2011.

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[Mg]	[Mg]	[Mg]	[Mg]	[g]	[kg]
1990	0.0842	0.0073	4.0822	0.0005	50.336	17.151
1991	0.0672	0.0067	3.7883	0.0004	24.922	8.681
1992	0.0443	0.0060	2.9857	0.0002	2.739	1.290
1993	0.0322	0.0058	2.8008	0.0004	2.126	0.983
1994	0.0291	0.0063	2.6535	0.0003	2.152	0.992
1995	0.0294	0.0062	3.1112	0.0003	2.163	0.992
1996	0.0251	0.0081	3.1123	0.0004	2.207	0.992
1997	0.0229	0.0082	2.6137	0.0006	6.109	2.942
1998	0.0207	0.0082	2.0886	0.0005	6.107	2.942
1999	0.0185	0.0082	1.5641	0.0005	1.740	0.757
2000	0.0163	0.0082	1.0390	0.0005	1.738	0.757
2001	0.0163	0.0080	1.0523	0.0003	2.217	0.998
2002	0.0164	0.0082	1.0527	0.0004	2.220	0.998
2003	0.0163	0.0081	1.0527	0.0004	2.220	0.998
2004	0.0163	0.0081	1.0527	0.0004	2.220	0.998
2005	0.0163	0.0081	1.0525	0.0003	2.219	0.998
2006	0.0163	0.0081	1.0525	0.0003	2.219	0.998
2007	0.0163	0.0081	1.0526	0.0003	2.220	0.998
2008	0.0163	0.0081	1.0526	0.0003	2.220	0.998

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[Mg]	[Mg]	[Mg]	[Mg]	[g]	[kg]
2009	0.0163	0.0081	1.0527	0.0004	2.221	0.998
2010	0.0163	0.0081	1.0524	0.0003	2.218	0.998
2011	0.0163	0.0081	1.0525	0.0003	2.219	0.998
Trend 1990–2011	*-80.6%*	*10.9%*	*-74.2%*	*-37.1%*	*-95.6%*	*-94.2%*
Trend 2010–2011	*<0.1%*	*0.2%*	*<0.1%*	*1.9%*	*<0.1%*	*<0.1%*

Activity data

Fuel consumption is taken from (IEA JQ 2012).

Table 80: Fuel consumption from NFR 1 A 2 b Non-ferrous Metals 1990–2011.

NFR	1 A 2 b	1 A 2 b	1 A 2 b	1 A 2 b	1 A 2 b	1 A 2 b
Fuel		liquid	solid	gaseous	biomass	other
				[TJ]		
1990	55 628	5 786	38 113	11 730	0	0
1991	52 309	5 789	34 405	12 115	0	0
1992	45 275	5 609	28 135	11 531	0	0
1993	47 745	5 906	30 806	11 033	0	0
1994	50 762	6 229	32 286	12 247	0	0
1995	54 714	7 166	33 877	13 672	0	0
1996	54 990	6 046	32 100	16 824	20	0
1997	62 472	6 744	36 162	19 565	0	0
1998	56 745	8 658	28 856	19 231	0	0
1999	57 645	8 381	31 078	18 186	0	0
2000	61 242	10 544	33 047	17 651	0	0
2001	61 473	11 353	32 140	17 981	0	0
2002	64 473	8 441	37 354	18 679	0	0
2003	65 191	7 138	39 646	18 407	0	0
2004	68 807	9 022	39 456	20 329	0	0
2005	75 602	10 169	44 229	21 204	0	0
2006	74 207	9 847	43 138	21 222	0	0
2007	72 397	11 044	41 715	19 634	3	0
2008	71 699	10 201	42 628	18 864	5	0
2009	60 186	7 570	33 690	18 921	4	0
2010	67 372	8 666	40 528	18 176	2	0
2011	67 244	5 699	40 461	21 082	2	0
Trend 1990-2011	*20.9%*	*-1.5%*	*6.2%*	*79.7%*		
Trend 2010-2011	*-0.2%*	*-34.2%*	*-0.2%*	*16.0%*	*-10.4%*	

The following Table 81 shows fuel consumption and main pollutant emission factors of category *1 A 2 b* for the year 2010.

Table 81: NFR 1 A 2 b main pollutant emission factors and fuel consumption for the year 2010.

Fuel	**Source of NO_x, CO, NMVOC, SO_2 emission factors**	**Activity [TJ]**	**NO_x [kg/TJ]**	**CO [kg/TJ]**	**NMVOC [kg/TJ]**	**SO_2 [kg/TJ]**	**NH_3 [kg/TJ]**
Coke oven coke	(BMWA 1990) (1)	115	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) (1)	193	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	16	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) (2)	14	65.0	15.0	4.8	(6)0.5	2.70
Kerosene	(BMWA 1996) (3)	3	118.0	15.0	4.8	92.0	2.70
Natural Gas	(BMWA 1996) (1)	3 816	41.0	5.0	0.5	NA	1.00
LPG	(BMWA 1996) (4)	28	41.0	5.0	0.5	6.0(5)	1.00

(1) *Default emission factors for industry*

(2) *Default emission factors for district heating plants*

(3) *Upper values from residual fuel oil < 1% S and heating oil*

(4) *Values for natural gas are selected*

(5) *From (LEUTGÖB et al. 2003)*

(6) *10 ppm sulphur content*

3.1.4.4 NFR 1 A 2 c Chemicals

Category 1 A 2 c includes emissions from fuel combustion in chemicals manufacturing industry. Because the inventory is linked with the NACE/ISIC consistent energy balance, plants which mainly produce pulp are considered in this category. Main polluters are pulp and basic anorganic chemicals manufacturers. Fuel consumption is taken from the energy balance (IEA JQ 2012). Main pollutant emission factors used for emission calculation are industrial boilers default values or derived from plant specific measurements.

Emissions from this category are presented in the following tables.

Table 82: Emissions of SO_2, NO_x, NMVOC, NH_3 and CO as well as PM from NFR 1 A 2 c Chemicals 1990–2011.

Year	**SO_2**	**NO_x**	**NMVOC**	**NH_3**	**CO**	**TSP**	**PM10**	**PM2.5**
			[Gg]				**[Mg]**	
1990	0.76	1.69	0.10	0.03	0.80	0.32	0.29	0.24
1991	0.80	1.52	0.12	0.03	0.92	NE	NE	NE
1992	0.57	1.45	0.14	0.03	1.08	NE	NE	NE
1993	0.56	1.37	0.11	0.02	0.86	NE	NE	NE
1994	0.61	1.16	0.11	0.02	0.80	NE	NE	NE
1995	0.53	1.01	0.12	0.02	0.85	0.31	0.28	0.23
1996	0.65	1.17	0.15	0.03	1.07	NE	NE	NE
1997	0.74	1.31	0.14	0.03	1.09	NE	NE	NE
1998	0.66	1.17	0.12	0.03	0.96	NE	NE	NE

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
			[Gg]				[Mg]	
1999	0.78	1.64	0.14	0.04	1.20	NE	NE	NE
2000	0.71	1.53	0.15	0.04	1.19	0.46	0.41	0.34
2001	0.68	1.35	0.16	0.03	1.16	0.38	0.34	0.28
2002	0.76	1.35	0.21	0.02	1.40	0.44	0.40	0.33
2003	0.91	1.51	0.28	0.03	1.77	0.56	0.50	0.42
2004	0.88	1.48	0.33	0.02	2.02	0.61	0.54	0.45
2005	0.74	1.56	0.26	0.03	1.61	0.50	0.45	0.38
2006	0.53	1.31	0.21	0.03	1.32	0.42	0.38	0.32
2007	0.44	1.27	0.16	0.03	1.03	0.36	0.33	0.27
2008	0.47	1.33	0.19	0.03	1.19	0.40	0.36	0.30
2009	0.49	1.16	0.15	0.03	1.00	0.34	0.30	0.25
2010	0.62	1.31	0.22	0.03	1.33	0.45	0.41	0.34
2011	0.56	1.30	0.22	0.03	1.33	0.44	0.40	0.33
Trend 1990–2011	*-25.6%*	*-23.1%*	*117.8%*	*7.6%*	*66.7%*	*35.2%*	*35.2%*	*35.2%*
Trend 2010–2011	*-9.0%*	*-1.1%*	*0.3%*	*-0.6%*	*-0.2%*	*-3.0%*	*-3.0%*	*-3.0%*

Table 83: Emissions of heavy metals and POPs from NFR 1 A 2 c Chemicals 1990–2011.

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[Mg]	[Mg]	[Mg]	[Mg]	[g]	[kg]
1990	0.028	0.012	0.206	0.018	0.436	0.066
1991	0.028	0.013	0.238	0.020	0.485	0.073
1992	0.027	0.015	0.269	0.023	0.560	0.083
1993	0.015	0.011	0.180	0.017	0.408	0.059
1994	0.012	0.010	0.180	0.015	0.375	0.055
1995	0.009	0.008	0.202	0.016	0.396	0.058
1996	0.013	0.010	0.260	0.022	0.531	0.079
1997	0.012	0.011	0.228	0.022	0.535	0.078
1998	0.010	0.009	0.188	0.018	0.446	0.064
1999	0.015	0.013	0.229	0.027	0.657	0.095
2000	0.014	0.012	0.256	0.025	0.606	0.089
2001	0.010	0.010	0.251	0.020	0.482	0.069
2002	0.013	0.011	0.341	0.023	0.573	0.083
2003	0.018	0.014	0.474	0.031	0.756	0.112
2004	0.021	0.015	0.569	0.034	0.841	0.126
2005	0.018	0.012	0.457	0.028	0.702	0.106
2006	0.015	0.010	0.384	0.024	0.595	0.090
2007	0.013	0.008	0.287	0.020	0.505	0.077
2008	0.015	0.009	0.348	0.023	0.568	0.087

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[Mg]	[Mg]	[Mg]	[Mg]	[g]	[kg]
2009	0.012	0.008	0.280	0.018	0.462	0.070
2010	0.017	0.010	0.401	0.025	0.634	0.097
2011	0.017	0.010	0.404	0.025	0.629	0.097
Trend 1990–2011	*-40.4%*	*-12.2%*	*95.6%*	*43.3%*	*44.4%*	*47.4%*
Trend 2010–2011	*-0.7%*	*-1.8%*	*0.8%*	*-1.0%*	*-0.7%*	*-0.6%*

Activity data

Fuel consumption is taken from (IEA JQ 2012).

Table 84: Fuel consumption from NFR 1 A 2 c Chemicals 1990–2011.

NFR	1 A 2 c	1 A 2 c	1 A 2 c	1 A 2 c	1 A 2 c	1 A 2 c
Fuel		liquid	solid	gaseous	biomass	other
			[TJ]			
1990	16 090	1 057	1 101	9 364	2 898	1 670
1991	15 881	1 113	1 408	8 334	2 902	2 124
1992	17 234	777	1 945	8 833	3 258	2 421
1993	17 613	964	1 972	10 890	2 182	1 605
1994	16 344	1 192	1 582	9 972	1 808	1 790
1995	16 897	1 127	1 576	10 326	1 722	2 146
1996	18 767	1 182	1 946	10 348	2 662	2 629
1997	20 161	1 669	2 660	10 869	2 908	2 055
1998	18 403	1 386	2 622	10 483	2 197	1 715
1999	25 300	927	3 234	14 647	4 985	1 507
2000	25 232	638	2 604	15 782	3 950	2 258
2001	23 755	983	2 652	15 464	1 840	2 815
2002	24 058	757	2 643	14 951	1 579	4 129
2003	26 522	846	2 627	15 115	2 113	5 821
2004	27 375	816	2 497	15 125	1 680	7 257
2005	29 312	806	1 573	18 998	2 264	5 670
2006	24 704	699	1 116	15 853	2 329	4 707
2007	23 492	808	837	15 897	2 746	3 204
2008	25 608	762	753	17 482	2 523	4 088
2009	20 428	1 305	738	12 938	2 179	3 269
2010	22 895	1 346	810	13 181	2 773	4 786
2011	23 328	1 228	723	13 826	2 682	4 869
Trend 1990-2011	*45.0%*	*16.1%*	*-34.3%*	*47.6%*	*-7.4%*	*191.6%*
Trend 2010-2011	*1.9%*	*-8.8%*	*-10.7%*	*4.9%*	*-3.3%*	*1.7%*

Table 85 sumarizes activity data and emission factors for 2010. Underlined values indicate non default emission factors.

Table 85: NFR 1 A 2 c main pollutant emission factors and fuel consumption for the year 2010.

Fuel	**Source of NO_X, CO, NMVOC, SO_2 emission factors**	**Activity [TJ]**	**NO_X [kg/TJ]**	**CO [kg/TJ]**	**NMVOC [kg/TJ]**	**SO_2 [kg/TJ]**	**NH_3 [kg/TJ]**
Hard coal	(BMWA 1990) (1)	810	80.3(5)	150.0	15.0	60.0(9)	0.01
Coke oven coke	(BMWA 1990) (1)	0	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) (1)	1 042	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	232	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) (2)	55	65.0	15.0	4.8	0.5	2.70
Natural Gas	(BMWA 1996) (1)	13 181	41.0	5.0	0.5	NA	1.00
LPG	(BMWA 1996) (3)	18	41.0	5.0	0.5	6.0(4)	1.00
Industrial waste	(BMWA 1990) (1)	4 786	47.0(6)	200.0	38.00	65.00(6)	0.02
Solid biomass	(BMWA 1996) (1)	2 321	100.0(7)	72.00	5.0	30.0	5.00
Biogas	(BMWA 1990) (8)	226	150.0	5.0	0.5	NA	1.00

(1) *Default emission factors for industry*

(2) *Default emission factors for district heating plants*

(3) *Values for natural gas are selected*

(4) *From (LEUTGÖB et al. 2003)*

(5) *50% of hard coal are assigned to fluidized bed boilers in pulp industry with comparatively low EF. Emissions are taken from DKDB.*

(6) *About 50% of waste composition is known as MSW fractions and sludges. Remaining amount is assumed to be gaseous with low sulphur content. A comparison to DKDB is used for verification. The selected NO_x emission factor is taken from (WINDSPERGER et al. 2003). The SO_2 emission factor is derived from plant specific data of the DKDB.*

(7) *Assumed to be consumed by one plant. The selected NO_x emission factor is derived from plant specific data of the DKDB.*

(8) *Uncontrolled default emission factors for natural gas fired industrial boilers are selected.*

(9) *For hard coal an uncontrolled SO_2 emission factor of 600 kg/TJ with an control efficiency of 90% is assumed.*

(10) *10 ppm sulphur content*

3.1.4.5 NFR 1 A 2 d Pulp, Paper and Print

Category 1 A 2 d includes emissions from fuel combustion in pulp, paper and print industry. Plants which mainly produce pulp are considered in category *1 A 2 c Chemical*s except black liquor recovery boilers. In 2008 all black liquor recovery boilers are equipped with flue gas desulphurization and electrostatic precipitators. Additionally all fluidized bed boilers are equipped with electrostatic precipitators and/or fabric filters. A detailed description of boilers, emissions and emission controls is provided in the unpublished study (UMWELTBUNDESAMT 2005b).

Fuel consumption activity data is taken from the energy balance. SO_2 emissions are taken from (AUSTROPAPIER 2002–2009). TSP emissions are taken from (UMWELTBUNDESAMT 2005a). Other main pollutant emission factors used for emission calculation are industrial boilers default values.

Emissions from this category are presented in the following table.

Table 86: Emissions of SO_2, NO_x, NMVOC, NH_3 and CO as well as PM from NFR 1 A 2 d Pulp, Paper and Print 1990–2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
			[Gg]				[Mg]	
1990	4.300	6.998	0.741	0.066	4.084	1.056	0.950	0.781
1991	4.912	7.783	0.737	0.078	4.108	NE	NE	NE
1992	2.600	6.326	0.650	0.065	3.734	NE	NE	NE
1993	2.247	6.483	0.626	0.081	3.728	NE	NE	NE
1994	2.209	6.904	0.595	0.095	3.583	NE	NE	NE
1995	1.974	6.135	0.565	0.084	3.429	0.452	0.407	0.335
1996	1.956	5.499	0.481	0.070	2.955	NE	NE	NE
1997	2.023	6.564	0.442	0.094	2.918	NE	NE	NE
1998	1.706	5.823	0.368	0.072	2.386	NE	NE	NE
1999	1.295	5.568	0.300	0.079	2.134	NE	NE	NE
2000	1.216	5.014	0.222	0.059	1.628	0.341	0.307	0.252
2001	1.103	5.465	0.244	0.079	1.880	0.324	0.292	0.240
2002	1.315	4.564	0.221	0.059	1.656	0.350	0.315	0.259
2003	1.172	4.817	0.226	0.068	1.686	0.319	0.287	0.236
2004	1.172	4.715	0.232	0.062	1.728	0.331	0.298	0.245
2005	1.154	5.603	0.271	0.085	2.188	0.345	0.311	0.255
2006	1.198	5.175	0.255	0.069	2.037	0.275	0.248	0.204
2007	1.171	5.156	0.242	0.075	1.934	0.285	0.257	0.211
2008	1.086	5.063	0.241	0.072	1.880	0.216	0.194	0.160
2009	1.056	5.023	0.244	0.073	2.128	0.229	0.206	0.170
2010	1.168	5.186	0.253	0.075	2.139	0.221	0.199	0.164
2011	1.088	5.059	0.253	0.071	2.143	0.275	0.247	0.203
Trend 1990–2011	*-74.7%*	*-27.7%*	*-65.8%*	*6.8%*	*-47.5%*	*-74.0%*	*-74.0%*	*-74.0%*
Trend 2010–2011	*-6.9%*	*-2.5%*	*0.3%*	*-6.2%*	*0.2%*	*24.0%*	*24.0%*	*24.0%*

Table 87: Emissions of heavy metals and POPs from NFR 1 A 2 d Pulp, Paper and Print 1990–2011.

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[Mg]	[Mg]	[Mg]	[Mg]	[g]	[kg]
1990	0.144	0.066	0.618	0.003	0.487	0.097
1991	0.130	0.069	0.611	0.003	0.544	0.109
1992	0.115	0.064	0.606	0.003	0.494	0.099
1993	0.113	0.071	0.670	0.003	0.509	0.102
1994	0.099	0.071	0.679	0.004	0.615	0.123
1995	0.078	0.066	0.692	0.004	0.590	0.118
1996	0.070	0.058	0.645	0.004	0.581	0.117

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[Mg]	[Mg]	[Mg]	[Mg]	[g]	[kg]
1997	0.078	0.062	0.674	0.004	0.674	0.136
1998	0.071	0.059	0.618	0.004	0.625	0.126
1999	0.080	0.064	0.700	0.004	0.626	0.125
2000	0.072	0.061	0.625	0.004	0.601	0.120
2001	0.087	0.069	0.763	0.004	0.639	0.128
2002	0.070	0.060	0.619	0.004	0.573	0.115
2003	0.073	0.060	0.646	0.004	0.612	0.122
2004	0.075	0.063	0.668	0.004	0.598	0.120
2005	0.091	0.074	0.812	0.004	0.671	0.134
2006	0.087	0.070	0.775	0.004	0.635	0.127
2007	0.089	0.069	0.791	0.004	0.647	0.129
2008	0.093	0.070	0.794	0.004	0.651	0.130
2009	0.093	0.069	0.792	0.004	0.626	0.125
2010	0.100	0.073	0.839	0.004	0.664	0.133
2011	0.100	0.073	0.840	0.004	0.643	0.128
Trend 1990–2011	*-30.7%*	*10.7%*	*35.9%*	*31.8%*	*31.8%*	*31.8%*
Trend 2010–2011	*-0.7%*	*1.1%*	*0.1%*	*-3.2%*	*-3.2%*	*-3.2%*

Activity data

Fuel consumption is taken from (IEA JQ 2012).

Table 88: Fuel consumption from NFR 1 A 2 d Pulp, Paper and Print 1990–2011.

NFR	1 A 2 c	1 A 2 c	1 A 2 c	1 A 2 c	1 A 2 c	1 A 2 c
Fuel		liquid	solid	gaseous	biomass	other
			[TJ]			
1990	54 146	10 938	4 125	17 014	21 875	193
1991	60 402	14 236	5 531	18 348	22 100	188
1992	54 918	8 526	4 707	18 488	22 931	265
1993	56 523	8 798	4 461	16 018	27 016	231
1994	68 303	8 394	3 804	27 107	28 678	319
1995	65 725	6 717	3 972	24 573	29 987	476
1996	64 851	5 131	3 883	28 239	26 788	809
1997	75 402	6 622	4 694	33 480	30 539	67
1998	69 945	5 602	4 688	31 560	28 024	71
1999	69 551	2 974	3 656	31 284	31 501	136
2000	66 790	2 202	4 381	31 827	28 379	0
2001	70 952	2 301	3 679	30 331	34 527	113
2002	63 694	1 961	4 366	29 535	27 711	121
2003	67 991	2 133	3 876	33 039	28 741	202

NFR	1 A 2 c	1 A 2 c	1 A 2 c	1 A 2 c	1 A 2 c	1 A 2 c
Fuel		**liquid**	**solid**	**gaseous**	**biomass**	**other**
			[TJ]			
2004	66 448	1 705	4 285	30 645	29 566	246
2005	74 692	1 791	5 016	30 968	36 806	111
2006	70 747	1 631	5 238	29 050	34 679	149
2007	72 102	1 260	4 013	30 977	35 683	170
2008	72 430	1 066	3 678	32 059	35 497	130
2009	69 601	1 326	3 799	29 025	35 332	118
2010	73 801	913	3 548	31 853	37 346	142
2011	71 461	616	3 935	29 370	37 402	137
Trend 1990-2011	*32.0%*	*-94.4%*	*-4.6%*	*72.6%*	*71.0%*	*-28.9%*
Trend 2010-2011	*-3.2%*	*-32.5%*	*10.9%*	*-7.8%*	*0.1%*	*-3.0%*

Table 89 shows activity data and emission factors for 2010. SO_2 emission factors were derived from national default values for industrial boilers taken from (BMWA 1990) and not highly representative for single fuels. Black liquor recovery and fluidized bed boilers are fired with combined fuels and therefore NO_x emission factors are not always representative for single fuel types. Underlined values indicate non default emission factors.

Table 89: NFR 1 A 2 d main pollutant emission factors and fuel consumption for the year 2010.

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Hard coal	(BMWA 1990) (1)	3 548	120.0(9)	150.0	15.0	111.2	0.01
Brown coal	(BMWA 1990) (1)	NO	170.0	150.0	23.0	91.2	0.02
Brown coal briquettes	(BMWA 1990) (1)	NO	170.0	150.0	23.0	91.2	0.02
Coke oven coke	(BMWA 1990) (1)	NO	220.0	150.0	8.0	120.5	0.01
Residual fuel oil < 1% S	(BMWA 1996) (1)	94	118.0	10.0	0.8	15.8	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	745	235.0	15.0	8.0	68.5	2.70
Heating oil	(BMWA 1996) (2)	42	65.0	15.0	4.8	0.1	2.70
Kerosene	(BMWA 1996) (6)	NO	118.0	15.0	4.8	15.8	2.7
LPG	(BMWA 1996) (3)	31	41.0	5.0	0.5	6.0(4)	1.00
Natural Gas	(BMWA 1996) (1)	31 853	41.0	5.0	0.5	NA	1.00
Industrial waste	(BMWA 1990) (1)	142	100.0	200.0	38.00	22.4	0.02
Black liquor	(BMWA 1990) (1)	28 532	77.0(7)	20.0	4.0	22.4	0.02
Fuel wood	(BMWA 1996) (8)	551	110.0	370.0	5.00	10.3	5.00
Solid biomass	(BMWA 1996) (1)	7 482	120.0(9)	72.00	5.0	10.3	5.00
Biogas	(BMWA 1990) (5)	251	150.0	5.0	0.5	NA	1.00
Sewage sludge gas	(BMWA 1990) (5)	73	150.0	5.0	0.5	NA	1.00

(1) *Default emission factors for industry*

(2) *Default emission factors for district heating plants*

(3) *Values for natural gas are selected*

(4) *From (LEUTGÖB et al. 2003)*

(5) *Uncontrolled default emission factors for natural gas fired industrial boilers are selected.*

(6) *Upper values from residual fuel oil < 1% S and heating oil*

(7) *NO_x emission factor for black liquor is derived from partly continuous measurements according to (UMWELTBUNDESAMT 2005a).*

(8) *Emission factors of wood chips fired district heating boilers are selected.*

(9) *NO_x emission factor of combinded hard coal, paper sludge and bark fired boilers is taken from (UMWELTBUNDESAMT 2003a).*

3.1.4.6 NFR 1 A 2 e Food Processing, Beverages and Tobacco

Category 1 A 2 e includes emissions from fuel combustion in food processing, beverages and tobacco industry. Due to the low fuel consumption it is assumed that default emission factors of uncontrolled industrial boilers are appropriate although it is known that sugar factories operate some natural gas and coke oven coke fired lime kilns. It is assumed that any type of secondary emission control is not occuring within this sector.

Emissions from this category are presented in the following table.

Table 90: Emissions of SO_2, NO_x, NMVOC, NH_3 and CO as well as PM from NFR 1 A 2 e Food Processing, Beverages and Tobacco 1990–2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
			[Gg]				[Mg]	
1990	1.646	1.739	0.021	0.021	0.198	0.120	0.108	0.090
1991	1.923	1.771	0.026	0.023	0.203	NE	NE	NE
1992	0.902	1.459	0.020	0.021	0.158	NE	NE	NE
1993	0.782	1.324	0.016	0.022	0.192	NE	NE	NE
1994	0.891	1.272	0.020	0.022	0.169	NE	NE	NE
1995	0.729	1.094	0.017	0.023	0.146	0.089	0.080	0.067
1996	0.518	0.931	0.014	0.020	0.119	NE	NE	NE
1997	0.585	1.084	0.015	0.024	0.134	NE	NE	NE
1998	0.481	0.952	0.014	0.021	0.118	NE	NE	NE
1999	0.314	0.798	0.013	0.018	0.114	NE	NE	NE
2000	0.419	0.868	0.016	0.019	0.142	0.062	0.055	0.046
2001	0.348	0.872	0.018	0.022	0.142	0.048	0.044	0.036
2002	0.488	1.053	0.021	0.024	0.159	0.082	0.074	0.062
2003	0.401	0.907	0.018	0.021	0.151	0.054	0.049	0.041
2004	0.308	0.881	0.016	0.022	0.149	0.031	0.027	0.023
2005	0.322	0.929	0.017	0.023	0.163	0.044	0.040	0.033
2006	0.313	0.916	0.017	0.023	0.152	0.044	0.040	0.033
2007	0.294	0.871	0.016	0.021	0.143	0.043	0.038	0.032

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
			[Gg]				[Mg]	
2008	0.263	0.840	0.015	0.020	0.134	0.035	0.031	0.026
2009	0.279	0.912	0.016	0.021	0.144	0.042	0.038	0.032
2010	0.222	0.850	0.015	0.020	0.141	0.030	0.027	0.022
2011	0.204	0.781	0.014	0.019	0.130	0.025	0.022	0.019
Trend 1990–2011	*-87.6%*	*-55.1%*	*-34.0%*	*-13.4%*	*-34.4%*	*-0.1%*	*-0.1%*	*-0.1%*
Trend 2010–2011	*-7.8%*	*-8.2%*	*-11.0%*	*-9.0%*	*-7.8%*	*<0.1%*	*<0.1%*	*<0.1%*

Table 91: Emissions of heavy metals and POPs from NFR 1 A 2 e Food Processing, Beverages and Tobacco 1990–2011.

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[Mg]	[Mg]	[Mg]	[Mg]	[g]	[kg]
1990	0.0020	0.0010	0.0053	0.0017	0.0294	0.0039
1991	0.0022	0.0011	0.0051	0.0019	0.0310	0.0040
1992	0.0015	0.0006	0.0032	0.0015	0.0220	0.0029
1993	0.0013	0.0009	0.0053	0.0020	0.0325	0.0043
1994	0.0012	0.0007	0.0038	0.0017	0.0279	0.0036
1995	0.0009	0.0004	0.0028	0.0014	0.0220	0.0030
1996	0.0005	0.0003	0.0019	0.0011	0.0185	0.0023
1997	0.0005	0.0003	0.0018	0.0013	0.0200	0.0024
1998	0.0004	0.0003	0.0015	0.0010	0.0174	0.0021
1999	0.0007	0.0004	0.0052	0.0013	0.0302	0.0042
2000	0.0008	0.0007	0.0063	0.0016	0.0391	0.0052
2001	0.0008	0.0006	0.0065	0.0017	0.0374	0.0052
2002	0.0010	0.0006	0.0065	0.0016	0.0401	0.0055
2003	0.0008	0.0006	0.0055	0.0016	0.0350	0.0048
2004	0.0005	0.0004	0.0040	0.0014	0.0286	0.0038
2005	0.0010	0.0007	0.0084	0.0020	0.0454	0.0064
2006	0.0010	0.0006	0.0084	0.0020	0.0442	0.0063
2007	0.0009	0.0006	0.0078	0.0018	0.0415	0.0059
2008	0.0007	0.0005	0.0057	0.0015	0.0339	0.0047
2009	0.0006	0.0005	0.0044	0.0013	0.0302	0.0041
2010	0.0003	0.0003	0.0023	0.0009	0.0222	0.0028
2011	0.0002	0.0003	0.0021	0.0009	0.0210	0.0026
Trend 1990–2011	*-88.5%*	*-65.3%*	*-60.0%*	*-47.3%*	*-28.6%*	*-32.5%*
Trend 2010–2011	*-17.0%*	*-1.0%*	*-7.3%*	*-2.9%*	*-5.5%*	*-6.5%*

Activity data

Fuel consumption is taken from (IEA JQ 2012).

Table 92: Fuel consumption from NFR 1 A 2 e Food Processing, Beverages and Tobacco 1990–2011.

NFR	1 A 2 e	1 A 2 e	1 A 2 e	1 A 2 e	1 A 2 e	1 A 2 e
Fuel		**liquid**	**solid**	**gaseous**	**biomass**	**other**
			[TJ]			
1990	13 906	4 451	177	9 146	131	0
1991	14 758	5 108	197	9 328	124	0
1992	13 649	4 429	104	9 029	87	0
1993	13 970	4 992	203	8 622	153	0
1994	14 666	4 547	180	9 837	103	0
1995	15 097	4 402	61	10 531	103	0
1996	14 637	3 270	116	11 217	28	6
1997	17 084	4 019	134	12 910	15	6
1998	15 644	3 206	114	12 309	9	6
1999	14 269	2 141	76	11 827	225	0
2000	15 163	2 178	215	12 530	240	0
2001	15 739	3 126	120	12 220	272	0
2002	19 125	2 348	154	16 356	267	0
2003	16 038	2 943	155	12 709	231	0
2004	15 983	3 342	124	12 286	231	0
2005	16 667	3 191	131	12 848	498	0
2006	16 330	3 228	102	12 477	523	0
2007	15 578	2 766	107	12 160	546	0
2008	15 402	2 503	117	12 302	480	0
2009	16 487	2 806	135	13 103	443	0
2010	16 379	2 672	145	13 374	185	3
2011	14 742	2 567	151	11 779	243	2
Trend 1990-2011	*6.0%*	*-42.3%*	*-14.6%*	*28.8%*	*85.3%*	
Trend 2010-2011	*-10.0%*	*-3.9%*	*4.3%*	*-11.9%*	*30.9%*	*-23.8%*

Fuel consumption activity data is taken from the energy balance. Main pollutant emission factors used for emission calculation are industrial boilers default values taken from (BMWA 1990).

Table 93 sumarizes activity data and emission factors for 2010.

Table 93: NFR 1 A 2 e main pollutant emission factors and fuel consumption for the year 2010

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Hard coal	(BMWA 1990) (1)	9	250.0	150.0	15.0	600.0	0.01
Brown coal	(BMWA 1990) (1)	NO	170.0	150.0	23.0	630.0	0.02
Brown coal briquettes	(BMWA 1990) (1)	NO	170.0	150.0	23.0	630.0	0.02
Coke oven coke	(BMWA 1990) (1)	136	220.0	150.0	8.0	500.0	0.01
Residual fuel oil < 1% S	(BMWA 1996) (1)	1 158	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	97	235.0	15.0	8.0	398.0	2.70
Heating oil	(BMWA 1996) (2)	1 103	65.0	15.0	4.8	0.5	2.70
Kerosene	(BMWA 1996) (6)	NO	118.0	15.0	4.8	92.0	2,7
LPG	(BMWA 1996) (3, 8)	315	41.0	5.0	0.5	6.0(4)	1.00
Natural Gas	(BMWA 1996) (1)	13 374	41.0	5.0	0.5	NA	1.00
Industrial waste	(BMWA 1990) (1)	3	100.0	200.0	38.00	130.0	0.02
Fuel wood	(BMWA 1996) (7)	35	110.0	370.0	5.00	11.0	5.00
Solid biomass	(BMWA 1996) (1)	1	134.0	72.00	5.0	60.0	5.00
Biogas	(BMWA 1990) (5)	131	150.0	5.0	0.5	NA	1.00

(1) *Default emission factors for industry*

(2) *Default emission factors for district heating plants*

(3) *Values for natural gas are selected*

(4) *From (LEUTGÖB et al. 2003)*

(5) *Uncontrolled default emission factors for natural gas fired industrial boilers are selected.*

(6) *Upper values from residual fuel oil < 1% S and heating oil.*

(7) *Emission factors of wood chips fired district heating boilers are selected.*

(8) *According to a sample survey (WINDSPERGER et al. 2003) natural gas NO_x emissions factors are in the range of 41 (furnaces) to 59 (boilers) kg/TJ.*

3.1.4.7 NFR 1 A 2 f i Other mobile in industry – soil abrasion

PM emissions from abrasion of offroad machinery are estimated by means of machinery stock, average operating hours and an PM emission factor of 30 [g TSP/machine operating hour]. The share in TSP emissions is 45% for PM10 and 12% for PM2.5. The following Table 94 presents the parameters used for 2011 emission calculation. Emission factors are taken from (WINIWARTER et al. 2007). Activity data is consistent with activity data used for calculation of exhaust emissions.

Table 94: Industry offroad machinery parameters for the year 2011.

Machinery	Stock	Avg. operating hours/year
Large construction equipment	13 621	1 260
Small construction equipment	85 618	441
Large industry equipment	1 126	421
Small industry equipment	1 644	303
Total	**102 009**	

3.1.4.8 NFR 1 A 2 f ii Other Manufacturing Industries

Category 1 A 2 f includes emissions from fuel combustion in other manufacturing industries. It considers furnaces and kilns of cement, lime, bricks/tiles and glass manufacturing industries, magnesit sinter plants, asphalt concrete plants, fine ceramic materials production as well as boilers of all industrial branches not considered in categories *1 A 2 a* to *1 A 2 e*.

Emissions from this category are presented in the following table.

Table 95: Emissions of SO_2, NO_x, NMVOC, NH_3 and CO as well as PM from NFR 1 A 2 f ii Other Manufacturing Industries 1990–2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
			[Gg]				[Mg]	
1990	4.184	13.848	0.283	0.201	11.071	0.438	0.395	0.329
1991	3.900	13.766	0.300	0.203	11.892	NE	NE	NE
1992	2.831	13.233	0.307	0.209	11.810	NE	NE	NE
1993	3.426	13.197	0.318	0.214	11.257	NE	NE	NE
1994	2.758	12.664	0.283	0.211	11.057	NE	NE	NE
1995	3.083	11.716	0.254	0.189	8.322	0.497	0.447	0.373
1996	4.033	12.223	0.301	0.200	8.973	NE	NE	NE
1997	5.393	12.464	0.381	0.193	8.419	NE	NE	NE
1998	3.925	11.475	0.312	0.195	8.170	NE	NE	NE
1999	2.790	10.720	0.318	0.195	8.635	NE	NE	NE
2000	2.491	10.675	0.310	0.199	8.197	0.674	0.607	0.506
2001	2.300	10.443	0.356	0.202	8.595	0.650	0.585	0.487
2002	1.917	10.812	0.294	0.188	7.544	0.604	0.544	0.453
2003	2.424	11.834	0.313	0.196	8.905	0.740	0.666	0.555
2004	2.305	12.257	0.347	0.224	9.020	0.737	0.663	0.553
2005	3.005	12.220	0.412	0.246	9.039	0.963	0.866	0.722
2006	2.890	12.664	0.476	0.250	14.002	1.062	0.956	0.796
2007	3.116	13.319	0.540	0.337	16.292	1.401	1.261	1.051
2008	3.320	12.934	0.654	0.306	19.722	1.562	1.406	1.171
2009	3.337	11.767	0.624	0.233	18.478	1.586	1.427	1.189
2010	3.628	12.284	0.749	0.260	19.640	1.856	1.671	1.392
2011	4.282	12.936	0.784	0.260	21.348	2.157	1.941	1.618
Trend 1990–2011	*2.3%*	*-6.6%*	*176.5%*	*29.4%*	*92.8%*	*391.9%*	*391.9%*	*391.9%*
Trend 2010–2011	*18.0%*	*5.3%*	*4.6%*	*<0.1%*	*8.7%*	*16.2%*	*16.2%*	*16.2%*

Table 96: Emissions of heavy metals and POPs from NFR 1 A 2 f ii Other Manufacturing Industries 1990–2011.

Year	**Cd**	**Hg**	**Pb**	**PAH**	**Diox**	**HCB**
	[Mg]	**[Mg]**	**[Mg]**	**[Mg]**	**[g]**	**[kg]**
1990	0.127	0.713	4.404	0.023	0.752	0.126
1991	0.142	0.593	4.641	0.025	0.830	0.138
1992	0.138	0.445	3.862	0.024	0.799	0.134
1993	0.141	0.305	3.522	0.025	0.799	0.133
1994	0.144	0.158	3.376	0.023	0.787	0.132
1995	0.105	0.107	2.986	0.021	0.739	0.126
1996	0.096	0.102	2.535	0.025	0.845	0.143
1997	0.075	0.118	1.855	0.016	0.610	0.107
1998	0.048	0.103	1.377	0.020	0.739	0.127
1999	0.062	0.118	1.034	0.039	1.207	0.196
2000	0.055	0.118	0.515	0.033	1.072	0.178
2001	0.049	0.148	0.553	0.035	1.125	0.188
2002	0.042	0.145	0.524	0.033	1.150	0.192
2003	0.056	0.167	0.548	0.039	1.282	0.212
2004	0.057	0.144	0.569	0.043	1.406	0.233
2005	0.071	0.166	0.691	0.055	1.644	0.262
2006	0.085	0.190	0.735	0.062	1.809	0.289
2007	0.095	0.203	0.959	0.082	2.349	0.374
2008	0.091	0.217	1.086	0.092	2.599	0.413
2009	0.084	0.207	1.065	0.092	2.552	0.402
2010	0.094	0.185	1.334	0.108	2.983	0.472
2011	0.106	0.187	1.530	0.124	3.417	0.539
Trend 1990–2011	*-16.4%*	*-73.8%*	*-65.3%*	*450.5%*	*354.3%*	*329.5%*
Trend 2010–2011	*0.127*	*0.713*	*4.404*	*0.023*	*0.752*	*0.126*

Table 97: Fuel consumption from NFR 1 A 2 f ii Other Manufacturing Industries 1990–2011.

NFR	**1 A 2 f ii**	1 A 2 f ii	1 A 2 f ii	1 A 2 f ii	1 A 2 f ii	1 A 2 f ii
Fuel		**liquid**	**solid**	**gaseous**	**biomass**	**other**
				[TJ]		
1990	55 507	14 479	6 558	28 385	4 728	1 357
1991	58 177	15 532	5 889	29 442	5 070	2 244
1992	59 065	12 726	6 642	32 294	4 818	2 585
1993	59 665	17 533	5 697	29 313	4 779	2 343
1994	61 574	16 520	4 305	33 619	4 512	2 617
1995	63 209	14 907	4 793	36 782	4 079	2 648
1996	66 354	16 286	5 796	36 321	5 045	2 905

NFR	**1 A 2 f ii**	1 A 2 f ii	1 A 2 f ii	1 A 2 f ii	1 A 2 f ii	1 A 2 f ii
Fuel		**liquid**	**solid**	**gaseous**	**biomass**	**other**
				[TJ]		
1997	62 755	21 833	6 361	30 153	843	3 565
1998	61 155	18 677	6 047	29 593	2 739	4 099
1999	56 731	12 113	4 935	26 836	9 102	3 745
2000	59 091	10 493	5 442	30 898	8 265	3 992
2001	58 908	11 045	4 731	29 255	8 528	5 349
2002	55 994	8 491	3 402	30 757	8 209	5 135
2003	61 799	11 789	2 866	32 519	9 750	4 875
2004	66 811	13 153	2 870	34 268	10 069	6 449
2005	76 183	12 814	4 790	38 274	13 964	6 343
2006	78 996	12 178	6 114	37 539	15 730	7 435
2007	84 173	10 455	6 915	37 124	21 202	8 476
2008	86 453	9 063	6 546	37 271	22 511	11 062
2009	85 027	8 479	5 467	37 744	21 961	11 376
2010	91 771	9 108	3 785	40 535	24 339	14 004
2011	93 268	10 023	3 592	36 117	27 320	16 216
Trend 1990-2011	*68.0%*	*-30.8%*	*-45.2%*	*27.2%*	*477.8%*	*1095.0%*
Trend 2010-2011	*1.6%*	*10.0%*	*-5.1%*	*-10.9%*	*12.2%*	*15.8%*

Table 98 shows total fuel consumption and emissions of main pollutants for sub categories of *1 A 2 f* for the year 2010.

Table 98: NFR 1 A 2 f ii Other Manufacturing Industries. Fuel consumption and emissions of main pollutants by sub category for the year 2010.

Category	**Fuel Consumption [TJ]**	**NO_x [Gg]**	**CO [Gg]**	**NMVOC [Gg]**	**SO_2 [Gg]**	**NH_3 [Gg]**
SNAP 0301 Other boilers	67 678	4.71	2.74	0.27	2.59	0.13
SNAP 030311 Cement Clinker Production	11 600	4.00	13.36	0.29	0.23	0.18
SNAP 030312 Lime Production	2 667	0.86	0.09	0.00	0.15	0.00
SNAP 030317 Glass Production	3 049	0.91	0.02	0.00	0.12	0.00
SNAP 030319 Bricks and Tiles Production	3 245	0.99	0.10	0.01	0.20	0.01
SNAP 030323 Magnesia Production	3 532	1.04	0.10	0.01	0.05	0.00
Total	**91 771**	**12.50**	**16.41**	**0.58**	**3.33**	**0.32**

Other manufacturing industry – boilers (SNAP 0301)

This sub category includes emissions of industrial boilers not considered in categories 1 A 2 a to 1 A 2 e. No specific distinction of technologies is made but national default emission factors of industrial boilers (BMWA 1990) are taken for emission calculation. It is assumed that facilities are not equipped with secondary emission controls. Activity data is taken from the energy balance.

Activity data and main pollutant emission factors are shown in Table 102.

Cement clinker manufacturing industry (SNAP 030311)

Currently nine cement clinker manufacturing plants are operated in Austria. Some rotary kilns are operated with a high share of industrial waste. In 2006 all exhaust streams from kilns and product heat recovery units were controlled by electrostatic precipitators. All plants are equipped with continuous emission measurement devices for PM, NO_x and $SO_{x,}$ four plants with CO, two plants with TOC and one plant with a continous Hg measurment device (MAUSCHITZ 2004). Annual activity data for 1990 to 2008 and emissions of 25 pollutants of all plants are estimated in periodic surveys (HACKL & MAUSCHITZ 1995, 1997, 2001, 2003, 2007), (MAUSCHITZ 2004) and (ZEMENTINDUSTRIE 2009). Table 99 shows detailled fuel consumption data for 2010.

Table 99: Cement clinker manufacturing industry. Fuel consumption for the year 2010.

Fuel	Activity [TJ]
Hard coal	1 705
Brown coal	1 495
Petrol coke	691
Residual fuel oil < 1% S	12
Residual fuel oil 0.5% S	NO
Residual fuel oil ≥ 1% S	330
Natural Gas	134
Industrial waste	6 420
Pure biogenic residues	803
Total	**14 852**

Lime manufacturing industry (SNAP 030312)

This category includes emissions from natural gas fired lime kilns. From 1990 to 2004 it includes magnesit sinter plants because sectoral data is available from the year 2005 on only (ETS data). Natural gas consumption is calculated by subtracting natural gas consumption of glass manufacturing industry (SNAP 030317), bricks and tiles industry (SNAP 030319), magnesit sinter industry (SNAP 030323) and cement industry (SNAP 030311) from final consumption of energy balance category *Non Metallic Mineral Products*. Thus it is assumed that uncertainty of this "residual" activity data could be rather high especially for the last inventory year because the energy balance is based on preliminary data. Lime production data are shown in Table 100. Heavy metals emission factors are presented in the following subchapter. Fuel consumption and main pollutant emission factors are shown in Table 102.

Table 100: Lime production 1990 to 2011.

Year	Lime [kt]
1990	512 610
1991	477 135
1992	462 392
1993	479 883
1994	518 544
1995	522 934
1996	505 189
1997	549 952
1998	594 695
1999	595 978
2000	654 437
2001	666 633
2002	719 246
2003	756 140
2004	788 790
2005	760 464
2006	780 873
2007	782 000
2008	847 847
2009	695 019
2010	765 231
2011	810 275

Glass manufacturing industry (SNAP 030317)

This category includes emissions from glass melting furnaces. Fuel consumption 1990 to 1994 is taken from (WIFO 1996). For the years 1997 and 2002 fuel consumption, SO_2 and NO_x emissions are reported from the Austrian association of glass manufacturing industry to the Umweltbundesamt by personal communication. Activity data for the years in between are interpolated. Natural gas consumption 2003 to 2004 is estimated by means of glass production data and an energy intensity rate of 7.1 GJ/t glass. Fuel consumption from 2005 onwards is taken from ETS. NO_x and SO_2 emissions for missing years of the time series are calculated by implied emission factors derived from years were complete data is available. SO_2 emissions include process emissions. Fuel consumption and main pollutant emission factors are shown in Table 102. Table 101 shows the sum of flat and packaging glass production data 1990 to 2011. The share of flat glass in total glass production is about 5%.

Table 101: Glass production 1990 to 2011.

Year	Glass [kt]
1990	398 515
1991	458 666
1992	405 863
1993	406 222

Year	Glass [kt]
1994	434 873
1995	435 094
1996	435 094
1997	405 760
1998	405 760
1999	445 069
2000	375 348
2001	440 865
2002	389 497
2003	476 901
2004	356 702
2005	417 685
2006	448 176
2007	496 709
2008	504 213
2009	442 515
2010	498 156
2011	474 222

Bricks and tiles manufacturing industry (SNAP 030319)

This category includes emissions from fuel combustion in bricks and tiles manufacturing industry. Bricks are baked with continuously operated natural gas or fuel oil fired tunnel kilns at temperatures around 1000°C. The chlorine content of porousing material is limited by a national regulation (HÜBNER 2001b). Activity data 1990 to 1995 is communicated by the Austrian association of non metallic mineral industry. Activity data 1996 to 2004 are linearly extrapolated 1995 activity data. Activity data 2005 to 2008 is taken from ETS. For main pollutants default emissions factors of industry are selected except for natural gas combustion for which the NO_x emission factor (294 kg/TJ) is taken from (WINDSPERGER et al. 2003). Table 102 presents fuel consumption and main pollutant emission factors.

1 A 2 f ii Fuel consumption and main pollutant emission factors

Table 102 shows activity data and main pollutant emission factors of 1 A 2 f sub categories except for SNAP 030311 cement industry were emission factors are not available by type of fuel. Underlined cells indicate emission factors other than default values for industrial boilers.

Table 102: NFR 1 A 2 f main pollutant emission factors and fuel consumption for the year 2010 by sub category.

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
SNAP 0301 Other boilers							
Hard coal	(BMWA 1990)(1)	NO	250.0	150.0	15.0	600.0	0.01
Coke oven coke	(BMWA 1990)(1)	458	220.0	150.0	8.0	500.0	0.01
Brown coal	(BMWA 1990)(1)	NO	170.0	150.0	23.0	630.0	0.02
Residual fuel oil < 1% S	(BMWA 1996)(1)	2 574	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996)(1)	899	235.0	15.0	8.0	398.0	2.70
Heating oil, Diesel oil	(BMWA 1996)(2)	1 969	65.0	15.0	4.8	0.5	2.70
Kerosene	(BMWA 1996)(6)	4	118.0	15.0	4.8	92.0	2.70
LPG	(BMWA 1996)(3)	1 661	41.0	5.0	0.5	6.0(4)	1.00
Natural gas	(BMWA 1996)(1)	29 676	41.0	5.0	0.5	NA	1.00
Industrial waste	(BMWA 1990)(1)	7 576	100.0	200.0	38.00	130.0	0.02
Fuel wood	(BMWA 1996)(7)	3 056	110.0	370.0	5.00	11.0	5.00
Solid biomass	(BMWA 1996)(1)	19 723	143.0	72.00	5.0	60.0	5.00
Sewage sludge	(BMWA 1996)(1)	60	100.0	200.0	38.00	NA	0.02
Biogas	(BMWA 1990)(5)	22	150.0	4.0	0.5	NA	1.00
SNAP 030312 Lime manufacturing							
Solid Biomass	(BMWA 1996) (1)	129	143.0	72.00	5.00	60.00	5.00
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	136	235.0	15.0	8.0	398.0	2.70
Natural Gas	(BMWA 1996) (1)	2 402	294.0(8)	30.0(9)	0.5	NA	1.00
SNAP 030317 Glass manufacturing							
Residual fuel oil	(BMWA 1996) (1)	84	299.1	15.0	8.0	432.1(10)	2.70
LPG	(BMWA 1996) (3)	NO	299.1	5.0	0.5	34.1(10)	1.00
Natural Gas	(BMWA 1996) (1)	2 965	299.1	5.0	0.5	34.1(10)	1.00
SNAP 030319 Bricks and tiles manufacturing							
Brown coal	(BMWA 1990) (1)	73	170.0	150.0	23.0	630.0	0.02
Coke oven coke	(BMWA 1990) (1)	55	220.0	150.0	8.0	500.0	0.01
Petrol coke	(BMWA 1990) (1)	50	220.0	150.0	8.0	81.0(11)	0.01
Residual fuel oil < 1% S	(BMWA 1996) (1)	7	118.0	10.0	0.8	92.0	2.70
Residual fuel oil ≥ 1% S	(BMWA 1996) (1)	116	235.0	15.0	8.0	398.0	2.70
Heating oil, Diesel oil	(BMWA 1996)(2)	4	65.0	15.0	4.8	0.5	2.70
LPG	(BMWA 1996) (3)	25	41.0	5.0	0.5	6.0(4)	1.00
Natural Gas	(BMWA 1996) (1)	2 396	294.0(8)	5.0	0.5	NA	1.00
Industrial waste	(BMWA 1990) (1)	8	100.0	200.0	38.0	130.0	0.02
Solid biomass	(BMWA 1996) (1)	512	143.0	72.00	5.0	60.0	5.00

(1) *Default emission factors for industry.*

(2) *Default emission factors for district heating plants.*

(3) *Values for natural gas are selected.*

(4) *From (LEUTGÖB et al. 2003)*

(5) *Uncontrolled default emission factors for natural gas fired industrial boilers are selected.*

(6) *Upper values from residual fuel oil < 1% S and heating oil.*

(7) *Emission factors of wood chips fired district heating boilers are selected.*

(8) *NO_x emission factor of natural gas fired lime kilns and bricks and tiles production is taken from (WINDSPERGER et al. 2003).*

(9) *CO emission factor of natural gas fired lime kilns is assumed to be 5 times higher than for industrial boilers.*

(10) *SO_2 emission factors of fuels used for glass manufacturing include emissions from product processing.*

(11) *The same SO_2 emission factor as for SNAP 030323 Petrol coke is selected.*

3.1.4.9 Emission factors for heavy metals, POPS and PM in NFR 1 A 2

In the following the emission factors for heavy metals, POPs and PM which are used in NFR 1 A 2 are described.

3.1.4.10 Emission factors for heavy metals used in NFR 1 A 2

For cement industries (SNAP 030311) emission values were taken from (HACKL & MAUSCHITZ, 2001); in the Tables presented below implied emission factors (IEF) are given.

For the other sub categories emission factors were applied, references are provided below.

Coal

Emission factors for 1995 were taken from (Corinair 1995), Chapter B112, Table 12. For 1990 the emission factors were assumed to be 50% and for 1985 100% higher, respectively.

Fuel Oil

For fuel oil the same emission factors as for 1 A 1 were used.

Other Fuels

For fuel wood and wood wastes the value from (OBERNBERGER 1995) for plants > 4 MW was used for 1985 and 1990. For fuel wood from 1995 onwards the value taken from personal information about emission factors for wood waste from the author was used.

For wood wastes from 1995 onwards the value for fuel wood of category 1 A 4 a (7 mg/GJ for Cd, 2 mg/GJ for Hg and 50 mg/GJ for Pb, valid for small plants) and a value of 0.8 mg/GJ for Cd, 13 mg/GJ for Hg and 1.0 mg/GJ for Pb, respectively, which are valid for plants with higher capacity (measurements at Austrian fluid bed combustion plants by FTU in 1999/2000) was weighted according to the share of overall installed capacity of the Austrian industry (25% high capacity and 75% low [< 5 MW] capacity).

Table 103: Cd emission factors for NFR 1 A 2 Manufacturing Industries and Construction.

Cadmium EF [mg/GJ]	1985	1990	1995	2010
Coal				
102A Hard coal 107A Coke oven coke	0.20	0.15	0.10	0.10
102A Hard coal 030311 IEF!	1.13	0.56	0.79	0.02
105A Brown coal 106A brown coal briquettes	0.80	0.60	0.40	0.40
105A Brown coal 030311 IEF!	4.53	2.24	3.16	0.10
Oil				
204A Heating and other gas oil 2050 Diesel		0.02 (all years)		
203B light fuel oil		0.05 (all years)		
203B light fuel oil 030311 IEF!	0.28	0.19	0.40	0.01
203C medium fuel oil		0.50 (all years)		
203C medium fuel oil 030311 IEF!	0.28	0.19	0.40	0.01
203D heavy fuel oil	1.00	0.75	0.50	0.50
203D heavy fuel oil 030311 IEF!	5.66	2.79	3.95	0.12

Cadmium EF [mg/GJ]	**1985**	**1990**	**1995**	**2010**
Other Fuels				
111A Fuel wood 215A Black liquor	6.10	6.10	2.50	2.50
116A Wood waste 115A Industrial waste	6.10	6.10	2.35	2.35
115A Industrial waste 030311 IEF!	34.55	22.73	18.57	0.58

Table 104: Hg emission factors for NFR 1 A 2 Manufacturing Industries and Construction.

Mercury EF [mg/GJ]	**1985**	**1990**	**1995**	**2010**
Coal				
102A Hard coal 107A Coke oven coke	3.40	2.55	1.70	1.70
102A Hard coal 030311 IEF!	163.57	96.75	12.21	10.43
105A Brown coal 106A brown coal briquettes	8.80	6.60	4.40	4.40
105A Brown coal 030311 IEF!	423.36	250.40	31.61	26.99
Oil				
204A Heating and other gas oil 2050 Diesel	0.007 (all years)			
203B light fuel oil	0.015 (all years)			
203B light fuel oil 030311 IEF!	0.72	0.57	0.11	0.09
203C medium fuel oil	0.04 (all years)			
203C medium fuel oil 030311 IEF!	1.92	1.52	0.29	0.25
203D heavy fuel oil	0.75 (all years)			
203D heavy fuel oil 030311 IEF!	3.61	2.85	0.54	0.46
Other Fuels				
111A Fuel wood 215A Black liquor 116A Wood waste 115A Industrial waste	1.90	1.90	1.25	1.25
115A Industrial waste 030311 IEF!	91.41	72.09	8.98	7.67

Table 105: Pb emission factors for NFR 1 A 2 Manufacturing Industries and Construction.

LEAD EF [mg/GJ]	**1985**	**1990**	**1995**	**2010**
Coal				
102A Hard coal 107A Coke oven coke	12.00	9.00	6.00	6.00
102A Hard coal 030311 IEF!	144.44	33.36	3.37	0.21
105A Brown coal 106A brown coal briquettes	7.80	5.85	3.90	3.90
105A Brown coal 030311 IEF!	93.88	21.68	2.19	0.14
Oil				
204A Heating and other gas oil 2050 Diesel	0.02 (all years)			
203B light fuel oil	0.05 (all years)			
203B light fuel oil 030311 IEF!	0.60	0.19	0.03	0.002
203C medium fuel oil	1.20 (all years)			

LEAD EF [mg/GJ]	1985	1990	1995	2010
203C medium fuel oil 030311 IEF!	1.44	0.44	0.07	0.004
203D heavy fuel oil	0.25	0.19	0.13	0.13
203D heavy fuel oil 030311 IEF!	3.01	0.69	0.07	0.004
Other Fuels				
111A Fuel wood 215A Black liquor 116A Wood waste	26.3	26.3	21.15	21.15
115A Industrial waste	72.00 (all years)			
115A Industrial waste 030311 IEF!	866.62	266.85	40.50	2.53

Emission factors not related to fuel input

The following Tables show production data of iron and steel, non ferrous metals and other activity data for selected years used as activity data for calculating heavy metals and POPs emissions from products processing.

Table 106: Non ferrous metals *production [Mg].*

Year	Secondary Lead (SNAP 030307)	Secondary Copper (SNAP 030309)	Secondary Aluminium (SNAP 030310)	Nickel Production (SNAP 030324)
	[Mg]			
1990	23 511	79 742	60 000	638
1995	21 869	69 830	60 000	822
2000	21 869	69 830	190 000	4 000
2011	21 869	69 830	259 000	4 000

Sources of activity data are:

Secondary Lead: (ÖSTAT Industrie- und Gewerbestatistik)

Secondary Copper: Plant specific

Secondary Aluminium: (ÖSTAT Industrie- und Gewerbestatistik); (UMWELTBUNDESAMT 2000)

Nickel Production: (ÖSTAT Industrie- und Gewerbestatistik); (EUROPEAN COMMISSION 2000)

Table 107: Activity data for calculation of HM and POP emissions with EF not related to fuel input.

Year	Cast Iron Production [Mg]	Cement clinker [kt]	Cement [kt]
1990	110 000	3 693 539	4 679 409
1991	101 000	3 635 462	4 821 480
1992	83 000	3 820 397	4 822 304
1993	65 000	3 678 293	4 858 012
1994	68 000	3 791 131	4 762 651
1995	69 000	2 929 973	3 839 415
1996	64 997	2 915 956	3 779 074
1997	66 283	3 103 312	3 909 083
1998	74 118	2 869 035	3 668 076
1999	70 863	2 891 785	3 658 102
2000	74 654	3 052 974	4 046 916
2001	75 031	3 061 338	4 035 382

Year	Cast Iron Production [Mg]	Cement clinker [kt]	Cement [kt]
2002	70 680	3 118 227	4 060 949
2003	68 584	3 119 808	4 344 632
2004	75 704	3 222 802	4 355 735
2005	76 447	3 221 167	4 559 654
2006	80 782	3 653 477	4 885 515
2007	87 012	3 992 376	5 202 513
2008	86 639	3 996 243	5 309 156
2009	54 111	3 428 140	4 646 019
2010	65 463	3 097 043	4 254 004
2011	67 475	3 175 642	4 426 944

Table 108: Asphalt concrete production 1990 and 2011.

Year	Asphalt concrete [kt]
1990	403
2011	522

Emission factors for Iron and Steel: reheating furnaces were taken from (WINIWARTER & SCHNEIDER 1995).

Secondary lead is produced by two companies which use lead accumulators and plumbiferous metal ash as secondary raw materials. Lead recuperation is processed in rotary furnaces.

The emission factor for secondary lead for the years 1985 and 1990 were taken from (WINIWARTER & SCHNEIDER 1995), (VAN DER MOST et al. 1992) and (JOCKL & HARTJE 1991).

The emission factor for secondary lead production for 1995 was taken from (WINDSPERGER & TURI 1997). Measurements at Austrian facilities in 2000 showed that emissions decrease by about 80%, thus 20% of the value used for 1995 was used for the years from 2000 onwards.

The emission factors for secondary copper production base on measurements at an Austrian facility in 1994; as re-designs at the main Austrian facility do not influence emissions significantly, this values are also used for 2000.

The Pb emission factor for secondary aluminium production is based on the following regulations/assumptions: (i) TSP emissions from aluminium production is legally limited to 20 mg/m^3 (BGBl. II 1/1998 for Al), (ii) as the facilities have to be equipped with PM filter to reach this limit, the emissions are usually well below the legal emission limit, (iii) thus PM emissions were estimated to be 5 mg/m^3; (iv) using results from BAT documents (0.25% Pb content in PM; 126–527 mg PM/t Al; (BOIN et al. 2000) and (EUROPEAN COMMISSION, IPPC Bureau 2000) an emission factor of 200 mg/t Al was calculated.

For lime production the emission factors for cement production (taken from (HACKL & MAUSCHITZ 2001)) were used, as the two processes are technologically comparable.

Pb and Cd emission factors for glass production base on measurements at two Austrian facilities for the year 2000. As emission limits are legally restricted, and for 1995 the emission allowances were higher, for 1995 twice the value of 2000 was used. For 1990 and 1985 the Cd and Pb emission factors as well as the Hg emission factor were taken (WINIWARTER & SCHNEIDER 1995).

Heavy metals emissions from burning of fine ceramic materials arise if metal oxides are used as pigments for glaze. The emission factors for fine ceramic materials base on results from (BOOS 2001), assuming that HM concentrations in waste gas is 5% of raw gas concentrations.

Emission factors for nickel production base on measurements at the only relevant Austrian facility.

Table 109: HM emission factors not related to fuel input for NFR 1 A 2 Manufacturing Industries and Construction.

NFR	SNAP	Category Description	EF [mg/MG Product]		
			Cd	Hg	Pb
1 A 2 a	030302 X47	Iron and Steel: reheating furnaces	50	–	2 400
1 A 2 b	030307	Secondary lead	3 500–200[108]	–	389 000–24 000[108]
1 A 2 b	030309	Secondary copper	170	80	6 790
1 A 2 b	030310	Secondary aluminium	–	–	200
1 A 2 f	030312	Lime production	8.7	21	29
1 A 2 f	030317	Other glass	150–8[108]	50–30[108]	12 000–200[108]
1 A 2 f	030320	Fine ceramic materials	150	–	5 000
1 A 2 b	030324	Nickel production	5	570	230

Emission factors for POPs used in NFR 1 A 2

For cement industries the dioxin (PCDD/F) emission factor of 0.01 µg/GJ is derived from measured 0,02 ng TE/Nm³ at 10% O_2 (WURST & HÜBNER 1997) assuming a flue gas volume of 1 600–1 700 Nm³/t cement clinker (HÜBNER 2001b) and an average energy demand of 3.55 GJ/t cement clinker. HCB emission factors are taken from (HÜBNER 2001b). The PAK4 emission factor of 0.28 mg/GJ fuel input is derived on actual measurements communicated to the Umweltbundesamt.

The dioxin (PCDD/F) emission factor for bricks and tiles and lime production is based on findings of the study (WURST & HÜBNER 1997). HCB emissions were calculated on the basis of dioxin emissions and assuming a factor of 200.

For pulp and paper industries the dioxin emission factor of 0.009 µgTE/GJ for all fuels bases on measurements of fluidized bed combustors in pulp and paper industries (FTU 1997) and data from literature with typical fuel mixes (LAI-report 1995), (NUSSBAUMER 1994). HCB emissions were calculated on the basis of dioxin emissions and assuming a factor of 200.

For the other sub categories emission factors for plants with different capacities were applied, together with assumptions on plant structure of the Austrian industry mean values for each fuel were calculated. The IEFs (average EF per fuel category) were used for all years; they are presented in Table 111.

Emission factors for dioxin were taken from (FTU 1997) and measurements at Austrian plants (FTU 2000).

References for PAK emission factors are provided in the following table.

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[108] upper value for 1985, lower value for 2000; years in between were linearly interpolated

Table 110: Source of PAH emission factor of different fuels.

PAH4 EF [mg/GJ]	Small plants ≤ 0.35 MW	Medium plants 0.35–1 MW	Large plants 1–50 MW	Source of EF
Natural gas	0.04	NA	NA	Same EF as for 1 A 4 b, central heating; for larger plants not relevant
Heating oil	0.24	0.16	0.16	For small plants same EF as for 1 A 4 b, central heating; for larger plants: (UBA BERLIN 1998) (four times the value of BaP).
Fuel oil	0.24	0.24	0.24	(UBA BERLIN 1998) (four times the value of BaP)
Wood	85	2.7	0.055	For small plants Same EF as for 1 A 4 b, central heating; for larger plants: measurements at Austrian plants by (FTU 2000).
Coal	85	2	0.04	For small plants Same EF as for 1 A 4 b, central heating; for large plants: (UBA BERLIN, 1998) (four times the value of BaP). For medium plants: expert judgement[109].

For other oil products the same emission factors as for category 1 A 1 were used.

For gaseous biofuels the same emission factors as for gas were used.

Table 111: POP emission factors (average EF per fuel category) for 1 A 2 Manufacturing Industries and Construction.

EF	PCDD/F [µg/GJ]	HCB [µg/GJ]	PAK4 [mg/GJ]
All fuels in pulp and paper ind.	0.009	1.8	0.055
Coal			
Hard coal	0.042	4.5	2.0
Hard coal - Cement Industry (IEF 2010)	0.007	0.75	0.22
Brown coal	0.033	3.6	2.0
Brown coal - Cement Industry (IEF 2010)	0.005	0.60	0.22
Brown coal briquettes	0.064	6.6	2.0
Coke oven coke	0.052	5.5	2.0
Fuel Oil			
Fuel Oil	0.0009	0.12	0.24
Fuel Oil Cement Industry (IEF 2010)	0.0001	0.02	0.026
Heating and other gas oil	0.0006	0.095	0.18
Other Oil Products	0.0017	0.14	0.011
Gas			
Natural gas	0.0006	0.072	0.0032 (for iron and steel) 0 (other sub categories)
Natural gas - Cement Industry (IEF 2010)	0.0001	0.012	NA
LPG	0.0006	0.079	0.004

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[109] As the size structure for coal fired plants was not known, the EF for medium plants – which is the main size – was used for all activity data in this category.

EF	**PCDD/F [µg/GJ]**	**HCB [µg/GJ]**	**PAK4 [mg/GJ]**
Other Fuels			
Fuel Wood	0.083	13.0	2.7
Industrial waste Wood Waste	0.083	13.0	3.3
Industrial waste - Cement Industry (IEF 2010)	0.014	2.16	0.36
Gaseous biofuels	0.0006	0.072	0.0032

Emission factors not related to fuel input

Dioxin emission factors for reheating furnaces in iron and steel industries (foundries) were taken from (UBA BERLIN 1998) (average of hot air and cold air furnaces).

For calculation of PAK emissions from reheating furnaces in iron and steel industries the same emission factor as for coke in blast furnaces was used, as the coke fired reheating furnaces are technologically comparable to these.

HCB emissions for foundries were calculated on the basis of dioxin emissions and assuming a factor of 200.

The secondary lead dioxin emission factor of 3 µg/Mg product is derived from an assumed limit of 0.4 ng/Nm^3 flue gas.

Secondary copper is mainly produced by one company which uses scrap as raw material. In a first step black copper is produced in a toploader kiln which is a relevant source of dioxin emissions. Black copper is further converted into blister copper which is further processed in a natural gas fired anode kiln and finally refined by electrolysis. In the 1980s secondary copper production was a main emitter of dioxin and furan emissions in Austria. Since then emission control could be achieved by changing raw materials, process optimization and a flue gas afterburner.

The dioxin emission factor from secondary copper production for the years after 1991 was taken from (WURST & HÜBNER 1997), in the years before no emission control (thermo reactor) was operating, furthermore input materials with more impurities were used. Thus emissions for these years were estimated to be about 200 times higher.

HCB emissions for secondary copper production were estimated on the basis of dioxin emissions and a factor of 330 which was calculated from different measurements at an Austrian facility (HÜBNER et al. 2000).

Secondary aluminium is mainly produced by two companies which uses scrap as raw materials. The raw material is mainly processed in rotary kilns and in some cases in hearth type furnaces. The main driver for dioxin and furan emissions is the composition of processed raw material (Chlorine content). While in the early 1990s emissions were widely uncontrolled the facilities have been recently equipped with particle filters and flue gas afterburners.

The dioxin emission factors for secondary aluminium production for the years 1985–1989 was taken from the Belgian emission inventory, as in these years in Austrian facilities hexachloroethan was used which results in higher emissions (and the Belgian emission factor reflect this). For 1990 the emission factor was taken from (HÜBNER 2000). For 1999 onwards a reduction by 95% was assumed, as dioxin emission reduction measures in the main Austrian plant started to operate.

HCB emissions for secondary aluminium production were estimated on the basis of dioxin emissions and a factor of 500, which was calculated taken from (AITTOLA et al. 1996).

POPs emissions are released in asphalt concrete plants when the bitumen/flint mixture is heated.

As dioxin EF the mean value of the emission factors given in (US-EPA 1998) was applied.

The PAK emission factor for asphalt concrete plants was taken from (SCHEIDL 1996).

Nickel is mainly produced by one company which uses catalysts and other potential recyclable as raw material. The raw material is processed in a rotary kiln and an electric arc furnace. Dioxin emissions 1993 are taken from an emissions declaration. Dioxin emissions of the remaining time series are calculated by multiplying production data with the implied emission factor of 1993.

The dioxin emission factor for nickel production bases on measurements in the only relevant Austrian facility.

Table 112: POP emission factors not related to fuel input for Sector 1 A 2 Manufacturing Industries and Construction.

	Dioxin [µg/t]	**HCB [µg/t]**	**PAK4 [mg/t]**
030302 Iron and Steel: reheating furnaces	0.25	50	1.1
030307 Secondary lead	3	NA	NA
030309 Secondary copper	600–4[110]	200 000–1 300[110]	–
030310 Secondary aluminium	130/40–7[110]	65 000–3 500[110]	–
030313 Asphalt concrete plants	0.01	2.8	0.15
030324 Nickel production	13	2 600–2.25[110]	–

Emission factors for PM used in NFR 1 A 2

As already described in Chapter 1.3 the emission inventories of PM for different years were prepared by contractors and incorporated into the inventory system afterwards.

The emission factors were taken from (WINIWARTER et al. 2001) and were used for the whole time series except for

- cement production (NFR 1 A 2 f ii): emissions taken from (HACKL & MAUSCHITZ 1995/1997/2001/2003/2007) are included in category 2 A 1.
- NFR 1 A 2 d pulp, paper and print: emission values were taken from (AUSTROPAPIER 2002–2009).

For these sources IEFs are presented in the following Table. The shares of PM10 and PM2.5 were taken from (WINIWARTER et al. 2001).

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[110] Higher value for 1995/1990, lower value for 2000

Table 113: PM emission factors for NFR 1 A 2.

	TSP Emission Factors [g/GJ]				PM10	PM2.5
	1990	1995	2000	2010	[%]	[%]
Gas						
Natural gas & LPG	0.5				90	75
Natural gas - Pulp & Paper (IEF)	0.20	0.10	0.11	0.06	90	75
Coal						
Hard coal & Coke oven coke	45				90	75
Brown coal & Brown coal briquettes	50				90	75
Coal - Pulp & Paper industries (IEF)	8.02	3.97	4.48	2.49	95	80
Oil						
Light fuel oil & Gasoil	3.0				90	75
Medium fuel oil	35				90	75
Heavy fuel oil	65				90	75
Other kerosene	3.0				95	80
Oil - Pulp & Paper industries (IEF)	20.05	9.93	11.21	6.23	90	75
Other Fuels						
Fuel wood, Wood waste & Industrial waste	55				90	75
Fuel wood, Wood waste & Industrial waste - Pulp & Paper (IEF)	13.79	4.97	5.60	3.12	90	75
Black liquor - Pulp & Paper industries (IEF)	41.36	14.90	11.21	6.23	90	75
Gaseous biofuels	0.5				90	75
Gaseous biofuels - Pulp & Paper industries (IEF)	2.01	0.99	1.12	0.62	90	74

3.1.5 NFR 1 A 3 e Other Transportation-pipeline compressors (SNAP 010506)

Category 1 A 3 e considers emissions from uncontrolled natural gas powered turbines used for natural gas pipelines transport. The simple CORINAIR methodology is used for emissions calculation.

Activity data is taken from the energy balance. The following Table 114 shows activity data and main pollutant emission factors. The NO_x emission factor of 150 kg/TJ is an expert guess by Umweltbundesamt.

Table 114: NFR 1 A 3 e main pollutant emission factors and fuel consumption for the year 2008.

Fuel	Source of NO_x, CO, NMVOC, SO_2 emission factors	Activity [TJ]	NO_x [kg/TJ]	CO [kg/TJ]	NMVOC [kg/TJ]	SO_2 [kg/TJ]	NH_3 [kg/TJ]
Natural Gas	(BMWA 1996) (1)	10 368	150.0	5.0	0.5	NA	1.00

(1) Default emission factors for industry.

3.1.6 NFR 1 A 4 Other Sectors

Category *1 A 4 Other sectors* enfolds emissions from stationary fuel combustion in the small combustion sector. It also includes emissions from mobile sources in households and gardening including snow cats and skidoos as well as from agriculture and forestry.

Source Description

Category *1 A 4 Oher Sectors* includes emissions from stationary fuel combustion in the small combustion sector as well as from some mobile machinery. Emissions of public district heating plants are included in category *1 A 1 a Public Electricity and Heat.* Emissions of district heat generation delivered to third parties by industry are included in *1 A 2 Manufacturing Industries and Construction*. Data of energy sources used for space and warm water heating in housholds and the commercial sector are collected by Statistik Austria using micro census questionnaires. According to Statistik Austria a clear distinction between "real" public district heating or micro heating networks which serve several buildings under same ownership can not always be made by the interviewed person or interviewers.

Table 115 presents non combustion PM emission sources which have been estimated since the inventory 2007.

Table 115:PM emissions from non-combustion in 2011.

Source	NFR	PM2.5 [Mg]
Bonfire	1 A 4 a i	150
Open fire pits	1 A 4 a i	16
Barbecue	1 A 4 b i	763
Agriculture (off-site)	1 A 4 c ii	32
Forestry	1 A 4 c ii	86
Total		986

Table 116 shows NFR 1 A 4 category definitions partly taken from the IPCC 2006 Guidelines.

Table 116: NFR 1 A 4 category definitions.

Code Number and Name	Definitions
1 A 4 OTHER SECTORS	Combustion activities as described below, including combustion for the generation of electricity and heat for own use in these sectors.
1 A 4 a Commercial/Institutional	Fuel combustion in commercial and institutional buildings; all activities included in ISIC Divisions 41, 50, 51, 52, 55, 63–67, 70–75, 80, 85, 90–93 and 99. *Bonfire and open fire pits.*
1 A 4 b Residential	Fuel combustion in households.
1 A 4 b i Residential plants	Fuel combustion in buildings. *Barbecue.*
1 A 4 b ii Household and gardening (mobile) [107] (see page 158)	Fuel combusted in non commercial mobile machinery such as for gardening and other off road vehicles.
1 A 4 c Agriculture/Forestry/Fishing	Fuel combustion in agriculture, forestry, fishing and fishing industries such as fish farms. Activities included in ISIC Divisions 01, 02 and 05. Highway agricultural transportation is excluded.
1 A 4 c i Stationary	Fuels combusted in pumps, grain drying, horticultural greenhouses and other agriculture, forestry or stationary combustion in the fishing industry.

Code Number and Name				**Definitions**
1 A 4	c	ii	Off-road Vehicles and Other Machinery [107] (see page 158)	Fuels combusted in traction vehicles and other mobile machinery on farm land and in forests.
1 A 4	c	iii	National Fishing[107] (see page 158)	Fuels combusted for inland, coastal and deep-sea fishing. Fishing should cover vessels of all flags that have refuelled in the country (include international fishing).

Emissions from this category are presented in the following table.

Table 117: Emissions of SO_2, NO_x, NMVOC, NH_3 and CO as well as PM from NFR 1 A 4 a Commercial/Institutional 1990–2011.

Year	**SO_2**	**NO_x**	**NMVOC**	**NH_3**	**CO**	**TSP**	**PM10**	**PM2.5**
			[Gg]				**[Mg]**	
1990	5.232	3.377	0.671	0.071	11.332	0.810	0.745	0.676
1991	3.954	2.999	0.777	0.070	12.758	NE	NE	NE
1992	3.300	3.333	0.588	0.077	11.269	NE	NE	NE
1993	2.721	3.296	0.578	0.081	10.983	NE	NE	NE
1994	2.442	2.902	0.538	0.068	10.128	NE	NE	NE
1995	2.225	3.496	0.474	0.084	10.185	0.567	0.527	0.485
1996	2.652	3.672	0.529	0.096	10.302	NE	NE	NE
1997	2.493	2.957	1.368	0.105	13.860	NE	NE	NE
1998	2.172	2.740	1.265	0.098	11.867	NE	NE	NE
1999	2.570	3.552	2.064	0.118	17.014	NE	NE	NE
2000	2.017	2.958	2.043	0.093	17.604	0.635	0.588	0.541
2001	2.336	3.612	1.342	0.110	14.432	0.528	0.492	0.455
2002	2.175	3.387	1.099	0.107	11.871	0.515	0.481	0.446
2003	2.616	3.772	1.257	0.128	14.145	0.582	0.541	0.499
2004	1.890	3.409	1.159	0.117	12.718	0.561	0.521	0.482
2005	1.401	2.776	0.664	0.100	8.885	0.431	0.405	0.378
2006	1.562	3.102	0.584	0.107	8.279	0.422	0.397	0.371
2007	0.967	2.263	0.552	0.084	7.211	0.392	0.370	0.347
2008	1.118	2.399	0.573	0.104	7.623	0.424	0.398	0.373
2009	0.210	1.671	0.495	0.074	6.305	0.361	0.342	0.322
2010	0.381	2.145	0.552	0.080	7.073	0.374	0.354	0.333
2011	0.338	1.902	0.472	0.072	6.156	0.346	0.328	0.310
Trend 1990–2011	*-93.5%*	*-43.7%*	*-29.7%*	*1.5%*	*-45.7%*	*-57.3%*	*-56.0%*	*-54.1%*
Trend 2010–2011	*-11.4%*	*-11.3%*	*-14.6%*	*-10.5%*	*-13.0%*	*-7.5%*	*-7.2%*	*-6.8%*

Table 118: Emissions of heavy metals and POPs from NFR 1 A 4 a Commercial/Institutional 1990–2011.

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[Mg]	[Mg]	[Mg]	[Mg]	[g]	[kg]
1990	0.075	0.027	0.454	0.160	1.917	1.453
1991	0.064	0.027	0.403	0.148	1.794	1.336
1992	0.059	0.024	0.373	0.152	1.870	1.400
1993	0.041	0.020	0.262	0.115	1.431	1.031
1994	0.034	0.018	0.222	0.115	1.427	1.042
1995	0.026	0.016	0.179	0.109	1.369	0.981
1996	0.032	0.018	0.229	0.137	1.677	1.242
1997	0.033	0.020	0.235	0.144	1.717	1.256
1998	0.026	0.016	0.181	0.114	1.392	0.972
1999	0.044	0.020	0.338	0.157	1.820	1.245
2000	0.045	0.022	0.334	0.164	1.938	1.320
2001	0.030	0.018	0.221	0.111	1.437	0.934
2002	0.029	0.015	0.222	0.101	1.374	0.870
2003	0.034	0.019	0.256	0.123	1.625	1.032
2004	0.034	0.017	0.260	0.123	1.671	1.039
2005	0.030	0.014	0.233	0.110	1.682	1.010
2006	0.028	0.012	0.209	0.101	1.571	0.928
2007	0.027	0.010	0.198	0.096	1.521	0.895
2008	0.029	0.010	0.207	0.103	1.664	0.962
2009	0.023	0.008	0.166	0.080	1.279	0.753
2010	0.026	0.009	0.184	0.089	1.431	0.837
2011	0.022	0.008	0.159	0.076	1.233	0.721
Trend 1990–2011	*-70.3%*	*-71.4%*	*-64.9%*	*-52.8%*	*-35.7%*	*-50.4%*
Trend 2010–2011	*-13.5%*	*-13.1%*	*-13.5%*	*-14.5%*	*-13.8%*	*-13.9%*

Table 119: Emissions of SO_2, NO_x, NMVOC, NH_3 and CO as well as PM from NFR 1 A 4 b i Residential plants 1990–2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
			[Gg]				[Mg]	
1990	25.870	13.077	51.209	0.518	416.255	10.274	9.323	8.372
1991	24.347	14.322	55.133	0.575	456.018	NE	NE	NE
1992	21.374	13.134	49.552	0.539	413.398	NE	NE	NE
1993	18.179	12.575	49.480	0.552	391.905	NE	NE	NE
1994	16.282	11.527	44.924	0.514	356.944	NE	NE	NE
1995	15.990	12.223	47.021	0.557	368.749	9.592	8.709	7.826
1996	15.856	13.189	49.976	0.615	387.523	NE	NE	NE
1997	10.204	13.528	35.066	0.549	332.937	NE	NE	NE

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
			[Gg]				[Mg]	
1998	9.620	13.509	33.744	0.553	319.641	NE	NE	NE
1999	9.318	13.674	33.875	0.563	318.078	NE	NE	NE
2000	8.609	12.873	31.342	0.538	294.620	8.141	7.403	6.666
2001	8.382	13.325	32.490	0.559	302.648	8.448	7.680	6.911
2002	7.378	12.283	29.683	0.529	274.816	7.839	7.131	6.424
2003	6.877	12.224	28.631	0.529	262.359	7.638	6.950	6.263
2004	6.638	11.699	27.227	0.510	249.325	7.386	6.724	6.062
2005	6.164	12.399	28.982	0.566	270.656	7.823	7.117	6.411
2006	5.696	11.521	26.255	0.527	251.367	7.256	6.606	5.957
2007	4.781	10.779	24.878	0.497	236.511	7.007	6.383	5.758
2008	4.948	11.022	25.469	0.513	242.456	7.234	6.587	5.940
2009	1.970	10.455	23.910	0.504	227.533	6.942	6.324	5.706
2010	2.298	11.660	26.511	0.561	253.849	7.630	6.943	6.257
2011	1.925	10.211	23.103	0.498	221.385	6.871	6.260	5.649
Trend 1990–2011	*-92.6%*	*-21.9%*	*-54.9%*	*-3.9%*	*-46.8%*	*-33.1%*	*-32.9%*	*-32.5%*
Trend 2010–2011	*-16.2%*	*-12.4%*	*-12.9%*	*-11.2%*	*-12.8%*	*-10.0%*	*-9.8%*	*-9.7%*

Table 120: Emissions of heavy metals and POPs from NFR 1 A b 4 b i Residential plants 1990–2011.

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[Mg]	[Mg]	[Mg]	[Mg]	[g]	[kg]
1990	0.312	0.387	3.819	7.917	41.735	50.287
1991	0.346	0.427	4.231	8.680	46.018	55.688
1992	0.316	0.379	3.781	7.810	41.612	50.531
1993	0.301	0.335	3.422	7.733	39.442	48.025
1994	0.275	0.303	3.111	6.911	35.139	42.907
1995	0.286	0.302	3.136	7.313	36.538	44.848
1996	0.303	0.304	3.214	7.798	38.348	47.293
1997	0.270	0.253	2.745	6.900	33.406	41.419
1998	0.258	0.235	2.574	6.531	31.470	39.289
1999	0.257	0.227	2.501	6.463	31.000	39.066
2000	0.238	0.207	2.308	5.859	28.137	35.510
2001	0.249	0.209	2.362	6.179	29.475	37.010
2002	0.230	0.184	2.130	5.630	26.684	33.222
2003	0.224	0.171	2.018	5.469	25.680	31.734
2004	0.216	0.164	1.949	5.408	25.361	31.139
2005	0.236	0.169	2.032	5.873	27.108	34.819
2006	0.218	0.160	1.877	5.057	23.424	31.542
2007	0.213	0.150	1.793	4.789	22.069	29.901

Year	Cd	Hg	Pb	PAH	Diox	HCB
2008	0.219	0.155	1.852	4.816	22.203	30.176
2009	0.212	0.142	1.732	4.439	20.349	28.065
2010	0.236	0.159	1.926	4.954	22.725	31.727
2011	0.211	0.142	1.721	4.075	18.732	26.275
Trend 1990–2011	*-32.3%*	*-63.4%*	*-54.9%*	*-48.5%*	*-55.1%*	*-47.8%*
Trend 2010–2011	*-10.4%*	*-10.7%*	*-10.6%*	*-17.7%*	*-17.6%*	*-17.2%*

Table 121: Emissions of SO_2, NO_x, NMVOC, NH_3 and CO as well as PM from NFR 1 A 4 c i Agriculture/Forestry/Fishing - 1990–2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
			[Gg]				[Mg]	
1990	1.184	1.056	0.353	0.036	12.755	0.445	0.400	0.356
1991	0.878	1.037	0.393	0.036	14.264	NE	NE	NE
1992	0.792	0.955	0.364	0.034	13.513	NE	NE	NE
1993	0.595	0.798	0.366	0.031	13.214	NE	NE	NE
1994	0.483	0.654	0.324	0.026	11.653	NE	NE	NE
1995	0.491	0.729	0.364	0.030	13.101	0.467	0.420	0.374
1996	0.506	0.800	0.394	0.033	14.168	NE	NE	NE
1997	0.429	0.886	2.289	0.033	20.999	NE	NE	NE
1998	0.420	0.877	2.171	0.032	20.026	NE	NE	NE
1999	0.444	0.943	2.312	0.035	20.750	NE	NE	NE
2000	0.389	0.879	2.170	0.033	19.731	0.470	0.423	0.376
2001	0.388	0.935	2.258	0.036	20.458	0.505	0.454	0.404
2002	0.320	0.853	2.018	0.033	18.387	0.467	0.421	0.374
2003	0.334	0.917	2.008	0.036	18.070	0.482	0.434	0.386
2004	0.325	0.941	1.947	0.037	17.441	0.497	0.447	0.397
2005	0.230	0.936	1.789	0.040	17.084	0.514	0.463	0.411
2006	0.211	0.879	1.622	0.037	15.669	0.492	0.442	0.393
2007	0.188	0.900	1.591	0.039	15.211	0.517	0.465	0.413
2008	0.195	0.934	1.644	0.041	15.675	0.548	0.493	0.438
2009	0.151	0.928	1.592	0.042	15.053	0.548	0.494	0.439
2010	0.199	1.077	1.782	0.048	16.863	0.615	0.553	0.492
2011	0.176	0.953	1.558	0.042	14.741	0.539	0.485	0.431
Trend 1990–2011	*-85.2%*	*-9.7%*	*341.4%*	*18.9%*	*15.6%*	*21.2%*	*21.2%*	*21.2%*
Trend 2010–2011	*-11.6%*	*-11.5%*	*-12.6%*	*-11.4%*	*-12.6%*	*-12.4%*	*-12.4%*	*-12.4%*

Table 122: Emissions of heavy metals and POPs from NFR 1 A b 4 4 c i Agriculture/ Forestry/Fishing 1990–2011.

Year	**Cd**	**Hg**	**Pb**	**PAH**	**Diox**	**HCB**
	[Mg]	**[Mg]**	**[Mg]**	**[Mg]**	**[g]**	**[kg]**
1990	0.032	0.014	0.135	0.352	1.682	2.546
1991	0.036	0.015	0.152	0.394	1.881	2.851
1992	0.034	0.014	0.143	0.366	1.748	2.663
1993	0.035	0.013	0.137	0.366	1.722	2.658
1994	0.031	0.012	0.121	0.304	1.435	2.232
1995	0.035	0.013	0.134	0.355	1.660	2.595
1996	0.038	0.013	0.144	0.386	1.793	2.817
1997	0.037	0.012	0.136	0.368	1.696	2.689
1998	0.035	0.012	0.128	0.343	1.579	2.514
1999	0.038	0.012	0.134	0.369	1.692	2.697
2000	0.036	0.012	0.130	0.352	1.612	2.582
2001	0.040	0.012	0.141	0.393	1.793	2.875
2002	0.038	0.012	0.132	0.366	1.666	2.690
2003	0.040	0.012	0.137	0.388	1.758	2.844
2004	0.043	0.012	0.145	0.430	1.944	3.128
2005	0.050	0.014	0.168	0.516	2.325	3.741
2006	0.048	0.013	0.159	0.479	2.157	3.484
2007	0.051	0.015	0.172	0.520	2.339	3.777
2008	0.053	0.015	0.179	0.534	2.405	3.893
2009	0.056	0.016	0.186	0.557	2.504	4.061
2010	0.063	0.017	0.208	0.632	2.839	4.595
2011	0.056	0.015	0.185	0.538	2.416	3.938
Trend 1990–2011	*72.0%*	*13.2%*	*36.8%*	*52.7%*	*43.7%*	*54.7%*
Trend 2010–2011	*-11.4%*	*-11.3%*	*-11.4%*	*-14.9%*	*-14.9%*	*-14.3%*

3.1.6.1 Methodology

The CORINAIR methodology is applied.

Three technology-dependent main sub categories (heating types) are considered in this category:

1. Central Heatings (CH)
2. Apartment Heatings (AH)
3. Stoves (ST)

Information about type of heatings is collected by household micro census surveys carried out by STATISTIK AUSTRIA (formerly ÖSTAT) for the years 1988, 1990, 1992, 1999/2000, 2004, 2006, 2008 and 2010. Number of interviews, type of questionnaires and interview modes were not consistent for all micro census'. Up to the year 2000 householders were asked by face to face interviews wheras from 2004 on data were collected by telephone interviews. In 2006 a small sample of housheolds were additionally interrogated on a voluntary basis for their daily natural gas usage over a two week period each in winter and summer. The collected data was used to supplement and confirm micro census data.

New boilers such as condensing oil and gas boilers with comparatively low NO_x emissions, controlled pellet boilers, wood gasification boilers and wood chip fired boilers with comparatively low VOC, CO, PM and POPs emissions are considered from 2000 onwards.

For each technology fuel dependent emission factors are applied.

3.1.6.2 Activity data

Total fuel consumption for each of the sub categories of 1 A 4 is taken from the national energy balance. From the view of energy statistics compilers this sector is sometimes the residual of gross inland fuel consumption because fuel consumption data of energy industries and manufacturing industry is collected each year in more detail and therefore of higher quality. However, in case of the Austrian energy balance fuel consumption of the small combustion sector is modelled over time series in consideration of heating degree days and micro census data. Activity data by type of heating is selected as the following:

1 A 4 a Commercial/Institutional; 1 A 4 b i Agriculture/Forestry/Fishing

There is no information about the structure of devices within these categories. It is assumed that the fuel consumption reported in (IEA JQ 2012) is combusted in devices similar to central heatings and therefore the respective emission factors are applied.

Table 123: Fuel consumption from NFR 1 A 4 a Commercial/Institutional *1990–2011.*

NFR	1 A 4 a	1 A 4 a	1 A 4 a	1 A 4 a	1 A 4 a	1 A 4 a
Fuel		**liquid**	**solid**	**gaseous**	**biomass**	**other**
			[TJ]			
1990	37 796	18 685	952	12 754	2 048	3 356
1991	39 522	17 916	1 270	15 636	2 076	2 624
1992	48 608	18 289	895	24 218	1 952	3 253
1993	51 884	17 697	857	28 862	2 630	1 837
1994	43 278	15 582	816	22 321	2 581	1 978
1995	53 464	17 626	651	30 790	2 663	1 735
1996	54 590	23 703	659	24 804	2 527	2 897
1997	54 782	27 520	925	20 926	2 875	2 535
1998	51 299	24 713	731	21 366	2 877	1 612
1999	60 393	27 741	917	25 809	4 467	1 460
2000	50 284	17 827	1 091	25 243	4 744	1 379
2001	63 675	23 640	1 210	35 035	3 163	627
2002	61 033	24 929	836	31 671	2 981	618
2003	71 612	30 557	1 177	35 800	3 430	648
2004	71 637	23 385	857	42 785	4 087	523
2005	58 317	20 858	641	32 582	3 839	398
2006	61 692	22 882	516	34 265	3 757	272
2007	48 792	14 896	347	29 613	3 789	147
2008	55 949	20 827	246	30 570	4 285	21

NFR	1 A 4 a	1 A 4 a	1 A 4 a	1 A 4 a	1 A 4 a	1 A 4 a
Fuel		liquid	solid	gaseous	biomass	other
			[TJ]			
2009	41 238	13 856	186	23 760	3 416	21
2010	51 253	10 583	205	36 501	3 941	24
2011	46 833	8 648	182	34 566	3 417	21
Trend 1990-2011	23.9%	-53.7%	-80.9%	171.0%	66.9%	-99.4%
Trend 2010-2011	-8.6%	-18.3%	-11.2%	-5.3%	-13.3%	-13.8%

Table 124: Fuel consumption from NFR 1 A 4 c i Agriculture/Forestry/Fishing 1990–2011.

NFR	1 A 4 c i	1 A 4 c i	1 A 4 c i	1 A 4 c i	1 A 4 c i	1 A 4 c i
Fuel		liquid	solid	gaseous	biomass	other
			[TJ]			
1990	10 449	5 343	549	366	4 190	0
1991	10 464	4 710	617	440	4 698	0
1992	9 704	4 214	556	431	4 503	0
1993	8 430	2 889	442	474	4 624	0
1994	7 030	2 103	389	452	4 085	0
1995	7 889	2 305	368	488	4 729	0
1996	8 699	2 595	348	549	5 207	0
1997	8 647	2 701	270	564	5 111	0
1998	8 578	2 872	232	610	4 863	0
1999	9 161	3 166	223	577	5 196	0
2000	8 578	2 791	191	538	5 058	0
2001	9 105	2 730	178	602	5 595	0
2002	8 332	2 282	129	563	5 358	0
2003	8 912	2 555	101	595	5 661	0
2004	9 139	2 437	97	580	6 025	0
2005	9 214	1 419	72	616	7 107	0
2006	8 681	1 284	67	592	6 739	0
2007	8 903	1 000	67	554	7 282	0
2008	9 250	1 032	69	562	7 587	0
2009	9 199	626	45	585	7 943	0
2010	10 630	1 028	50	643	8 909	0
2011	9 415	902	45	571	7 897	0
Trend 1990-2011	*-9.9%*	*-83.1%*	*-91.9%*	*55.9%*	*88.5%*	
Trend 2010-2011	*-11.4%*	*-12.3%*	*-11.0%*	*-11.2%*	*-11.4%*	

1 A 4 b i Residential

Energy consumption by type of fuel and by type of heating is taken from a statistical evaluation of micro census data 1990, 1992, 1999, 2004, 2006, 2008 and 2010 (STATISTIK AUSTRIA). The calculated shares are used to subdivide total final energy consumption to the several technologies. For the years in between the shares are interpolated.

The share of natural gas and heating oil condensing boilers in central and apartment heatings and new biomass boilers is estimated by means of projected boiler change rates from (LEUTGÖB et al. 2003). A later comparison with sales statistics from the Austrian Association of Boiler Suppliers implies a yearly fuel consumption of about 3 t heating oil by boiler in 2004. For the year 2010 it is assumed that 27% of oil central heatings and 13% of oil apartement heatings have about half NOx emissions (20 kg NOX/TJ) than conventional heatings (42 kg NOX/TJ).

Pellet consumption 2004 (250 kt) is taken from a survey of the Provincial Chamber of Agriculture of Lower Austria. The inceasing pellet consumption 2005 (539 kt) to 2011 (689 kt) is taken from the national energy balance. Wood chip consumption is calculated by subtracting pellet consumption from non-fuelwood biomass consumption taken from energy statistics. Pellet boilers are considered to have lower PM, POPs, NMVOC and CO emissions than wood chips fired boilers.

The share of wood gasification or other modern wood boilers in total fuel wood fired heatings is calculated by an annual substitution rate of 3 000 central heatings from 1992 on assuming an average annual fuel consumption of 190 GJ/boiler which is approximately 10 t of fuel wood. Since 2001 fuel wood boiler sales are used for consumption estimates (about 13 000 new boilers yearly). The calculated average consumption rate of 172 GJ per boiler and year has been calculated by means of micro census data 2008 (33.3 PJ fuel wood used by 409 908 households, assuming that 2,12 households are sharing one boiler at avg.). Controlled wood gasification boilers are considered with lower POPs, NMVOC and CO emissions than manually operated heatings.

75 000 gasoil fired central heatings with blue flame burners are considered with lower PAH emissions than yellow flame burners. Activity data of blue flame burners are estimated by an average annual exchange rate of 4 200 boilers assuming an average annual consumption of 80 GJ/boiler (1.9 t heating oil equivalent) from 1991 on.

Table 125: Fuel consumption from NFR 1 A 4 b i Residential1990–2011.

NFR	**1 A 4 b i**	**1 A 4 b i**	**1 A 4 b i**	**1 A 4 b i**	**1 A 4 b i**	**1 A 4 b i**
Fuel		**liquid**	**solid**	**gaseous**	**biomass**	**other**
			[TJ]			
1990	190 751	72 504	26 637	33 338	58 271	0
1991	213 126	79 161	29 267	39 817	64 881	0
1992	198 068	72 694	25 243	38 788	61 343	0
1993	199 780	73 983	20 799	42 368	62 630	0
1994	185 857	69 121	18 522	40 175	58 039	0
1995	198 974	75 586	17 556	43 185	62 647	0
1996	217 890	83 886	16 643	48 579	68 782	0
1997	193 385	68 047	12 586	48 517	64 235	0
1998	196 456	71 306	11 047	51 369	62 735	0
1999	198 100	73 116	10 168	50 910	63 906	0
2000	188 900	72 597	8 931	47 491	59 881	0

NFR	**1 A 4 b i**	**1 A 4 b i**	**1 A 4 b i**	**1 A 4 b i**	**1 A 4 b i**	**1 A 4 b i**
Fuel		**liquid**	**solid**	**gaseous**	**biomass**	**other**
			[TJ]			
2001	196 629	71 550	8 402	53 106	63 571	0
2002	184 902	68 924	6 777	49 653	59 548	0
2003	186 033	69 074	5 612	52 454	58 894	0
2004	179 799	66 547	5 419	51 194	56 639	0
2005	194 150	70 084	4 268	54 341	65 457	0
2006	180 812	62 669	4 055	52 219	61 869	0
2007	167 655	54 197	3 155	48 910	61 393	0
2008	172 292	55 956	3 265	49 605	63 466	0
2009	168 975	52 293	2 128	51 582	62 972	0
2010	187 484	58 038	2 352	56 695	70 399	0
2011	165 861	50 267	2 044	50 354	63 196	0
Trend 1990-2011	*-13.0%*	*-30.7%*	*-92.3%*	*51.0%*	*8.5%*	
Trend 2010-2011	*-11.5%*	*-13.4%*	*-13.1%*	*-11.2%*	*-10.2%*	

Table 126 shows the selected share of each heating type for category *1.A.4.b.*

Table 126: Share of 1.A.4.b heating type on fuel category for the year 2010.

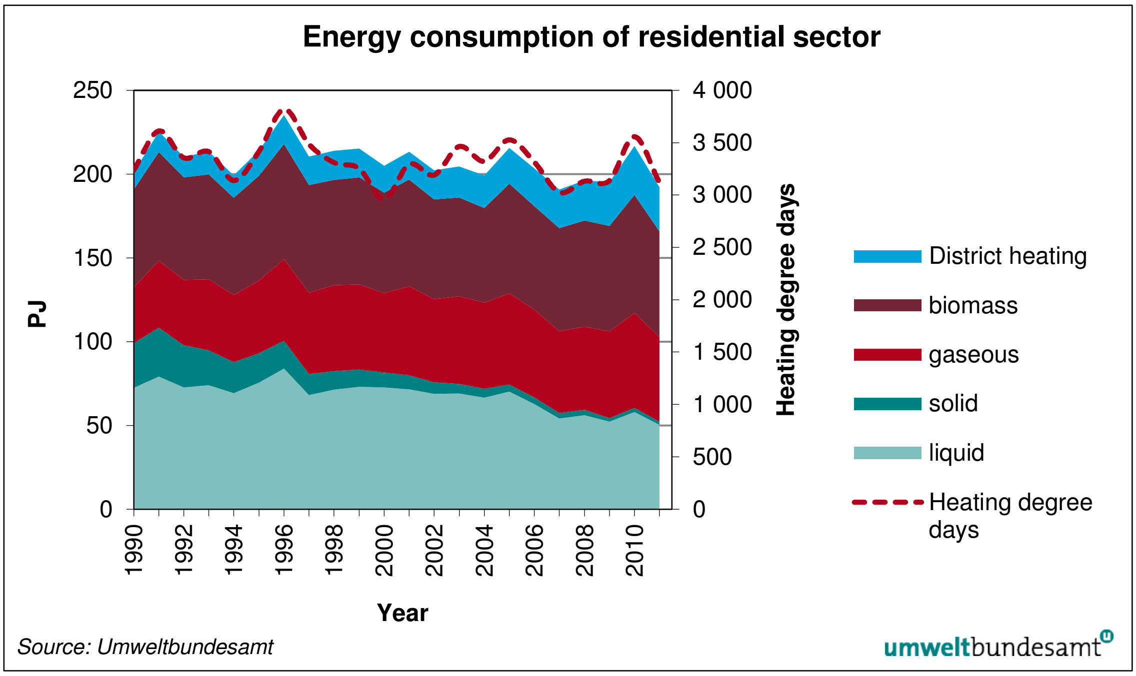
	Central Heating	**Appartement Heating**	**Stove**
Hard Coal	80%	5%	14%
Brown Coal			
Brown Coal Briquettes			
Coke			
Gas oil	94%	3%	3%
Residual Fuel Oil, Gas Works Gas, LPG, Petroleum	100%	–	–
Natural Gas	49%	47%	5%
Fuel Wood	79%	5%	16%
Wood Chips, Pellets, other solid biomass	95%	3%	2%

The following table shows biomass boiler sales from 2000 which are considered with lower CO, NMVOC and CH_4 emissions than equipment installed before 2000. The estimated accumulated consumption in 2011 is 47 PJ which is 75% of total biomass consumption of *1.A.4.b residential*. The average yearly consumption is calculated by average consumption per household. In case of boilers it is assumed that a building contains 2.12 households which are heated by a single boiler. The selected factors are derived from the 2008 household census.

Table 127: Number of biomass boiler sales 2000-2011 and fuel consumption estimate.

Year	Pellet boilers	Pellet stoves	Wood chip boilers	Log wood boilers
2000	3 466	0	0	0
2001	4 932	0	2 645	5 364
2002	4 492	997	2 615	4 276
2003	5 193	1 827	2 890	4 144
2004	6 077	3 245	3 224	4 555
2005	8 874	3 780	4 509	6 078
2006	10 467	5 640	4 726	6 937
2007	3 915	1 750	3 578	4 835
2008	11 101	3 045	4 096	7 405
2009	8 446	2 600	4 328	8 530
2010	8 131	2 000	3 656	6 211
2011	10 400	2 700	3 744	6 328
Accumulated total number	**85 494**	**27 584**	**40 011**	**64 663**
Avg. estimated yearly consumption per boiler or stove [GJ]	203	48	331	236
Total estimated consumption of new boilers 2010 [TJ]	17 363	1 324	13 232	15 230

Figure 23 shows activity data of *1.A.4.b Residential (without mobile machinery)* by type of fuel together with the correlating heating degree days for the years 1990 to 2011.



Source: Umweltbundesamt

Figure 23: Energy consumption [PJ] of residential sector by type of fuel and number of heating degree days 1990–2011.

Table 128: NFR 1 A 4 b i percentual consumption by type of heating.

Year	Natural Gas			Fuel Oil, LPG	Gasoil			Coal (+ Briquettes)		
	CH	AH	ST	CH	CH	AH	ST	CH	AH	ST
		[%]		[%]		[%]			[%]	
1990	22.6	38.4	39.1	100	75.0	10.0	15.0	60.6	9.4	30.0
1991	26.0	36.4	37.6	100	75.0	10.0	15.0	62.3	8.8	29.0
1992	28.6	37.8	33.5	100	76.2	9.4	14.4	63.9	8.6	27.5
1993	31.3	39.2	29.5	100	77.3	8.9	13.8	65.6	8.5	26.0
1994	33.9	40.6	25.4	100	78.5	8.3	13.3	67.3	8.3	24.5
1995	36.6	42.1	21.4	100	79.6	7.7	12.7	68.9	8.1	22.9
1996	39.2	43.5	17.3	100	80.8	7.2	12.1	70.6	8.0	21.4
1997	41.9	44.9	13.2	100	81.9	6.6	11.5	72.2	7.8	19.9
1998	44.5	46.3	9.2	100	83.1	6.0	10.9	73.9	7.7	18.4
1999	47.1	47.7	5.1	100	84.2	5.4	10.4	75.6	7.5	16.9
2000	47.1	47.7	5.1	100	84.2	5.4	10.4	75.6	7.5	16.9
2001	47.8	46.9	5.3	100	83.8	6.2	10.0	73.3	8.2	18.4
2002	48.5	46.0	5.5	100	83.4	7.0	9.7	71.1	9.0	19.9
2003	49.1	45.2	5.7	100	82.9	7.7	9.3	68.9	9.7	21.4
2004	49.8	44.4	5.9	100	82.5	8.5	9.0	66.7	10.4	22.9
2005	51.2	43.8	5.0	100	86.8	6.5	6.8	70.3	10.7	19.0
2007	52.6	43.2	4.2	100	91.0	4.4	4.6	73.8	11.1	15.1
2007	54.0	42.0	4.0	100	92.7	3.7	3.7	77.3	8.9	13.8
2008	55.4	40.8	3.8	100	94.4	2.9	2.8	80.8	6.7	12.4
2009	52.0	43.8	4.3	100	94.3	3.1	2.7	80.5	6.0	13.4
2010	48.5	46.8	4.7	100	94.2	3.3	2.6	80.2	5.3	14.4
2011	48.5	46.8	4.7	100	94.2	3.3	2.6	80.2	5.3	14.4

Table 129: NFR 1 A 4 b i Type of heatings split.

Year	**Fuel Wood (log wood)**			**Wood chips, pellets and other biomass**		
	CH	**AH**	**ST**	**CH**	**AH**	**ST**
		[%]			**[%]**	
1990	61.3	7.3	31.4	61.3	7.3	31.4
1991	62.9	6.1	31.0	62.9	6.1	31.0
1992	63.5	6.4	30.1	66.2	5.8	28.0
1993	64.1	6.6	29.3	69.5	5.4	25.1
1994	64.7	6.8	28.5	72.8	5.1	22.1
1995	65.3	7.1	27.6	76.1	4.7	19.1
1996	65.9	7.3	26.8	79.4	4.4	16.2
1997	66.5	7.5	26.0	82.8	4.0	13.2
1998	67.1	7.8	25.1	86.1	3.7	10.3
1999	67.7	8.0	24.3	89.4	3.3	7.3
2000	67.7	8.0	24.3	89.4	3.3	7.3
2001	67.0	7.5	25.5	88.6	3.3	8.1
2002	66.4	7.0	26.6	87.9	3.3	8.8
2003	65.7	6.5	27.7	87.2	3.3	9.6
2004	65.1	6.0	28.9	86.4	3.2	10.3
2005	70.6	5.9	23.5	87.7	3.3	9.0
2006	76.2	5.7	18.1	88.9	3.4	7.7
2007	76.2	5.7	18.0	90.1	3.1	6.8
2008	76.3	5.8	18.0	91.3	2.7	6.0
2009	77.6	5.3	17.1	93.2	3.0	3.8
2010	79.0	4.8	16.2	95.1	3.2	1.7
2011	79.0	4.8	16.2	95.1	3.2	1.7

3.1.6.3 Emission factors

Due to the wide variation of technologies, fuel quality and device maintenance the uncertainty of emission factors is rather high for almost all pollutants and technologies.

Country specific main pollutant emission factors from national studies (BMWA 1990), (BMWA 1996) and (UMWELTBUNDESAMT 2001a) are applied. In these studies emission factors are provided for the years 1987, 1995 and 1996.

Emission factors prior to 1996 are taken from (STANZEL et al. 1995) and mainly based on literature research.

Natural gas and heating oil emission factors 1996 are determined by means of test bench measurements of heatings sold in Austria. Solid fuels emission factors 1996 are determined by means of field measurements of Austrian small combustion devices.

NO_x emissions factors of heating oil and natural gas condensing boilers are taken from (LEUTGÖB et al. 2003).

For the years 1990 to 1994 emission factors were interpolated. From 1997 onwards the emission factors from 1996 are applied.

In some cases only VOC emission factors are provided in the studies, NMVOC emission factors are determined assuming that a certain percentage of VOC emissions is released as methane as listed in Table 130. The split follows closely (STANZEL et al. 1995).

Table 130: Share of CH_4 and NMVOC in VOC for small combustion devices.

	CH_4	**NMVOC**	**VOC**
Coal	25%	75%	100%
Gas oil; Kerosene	20%	80%	100%
Residual fuel oil	25%	75%	100%
Natural gas; LPG	80%	20%	100%
Biomass	25%	75%	100%

The following Tables show the main pollutant emission factors by type of heating.

Table 131: NFR 1 A 4 NO_x emission factors by type of heating for the year 2011.

	Central heating [kg/TJ]	**Apartement heating [kg/TJ]**	**Stove [kg/TJ]**
Coal	78.0	78.0	132.0
Residual fuel oil < 1% S	115.0		
Residual fuel oil ≥ 1% S	235.0		
Heating oil, Kerosene, LPG	42.0/37.5⁽³⁾ 20.0⁽²⁾	43.0 20.0⁽²⁾	55.0
Natural gas	42.0 16.0⁽²⁾	43.0 16.0⁽²⁾	51.0
Solid biomass	107.0	107.0	106.0
Industrial waste	100.0⁽¹⁾		

⁽¹⁾ Default values for industrial boilers

⁽²⁾ Condensing boilers (LEUTGÖB et al. 2003)

⁽³⁾ The value of 42 g NO_X/Gj is used until the year 2008. Since 2009 most of the gasoil placed into market has a lowered sulphur content of 10 ppm which is reflected in an emission factor of 37.5 g NO_X/GJ.

Table 132: NFR 1 A 4 NMVOC emission factors by type of heating for the year 2010.

	Central heating [kg/TJ]	**Apartement heating [kg/TJ]**	**Stove [kg/TJ]**
Coal	284.4	284.4	333.3
Residual fuel oil < 1% S	0.8		
Residual fuel oil ≥ 1% S	8.0		
Heating oil, Kerosene	0.8	0.8	1.5
LPG	0.5	0.5	
Natural gas	0.2	0.2	0.2
Solid biomass conventional	432.0	432.0	643.0 338.0⁽¹⁾

	Central heating [kg/TJ]	Apartement heating [kg/TJ]	Stove [kg/TJ]
Wood gasification	325.0(1)	312.0(1)	
Wood chips	78.0(1)		
Pellets	(3)35.0 (for all types of heating)		
Industrial waste	38.0(2)		

(1) *NMVOC from new biomass heatings (*L*ANG et al. 2003)*

(2) *Default values for industrial boilers*

(3) *Averaged emission factor fro new pellets heatings (*L*ANG et al. 2003)*

Table 133: NFR 1 A 4 CO emission factors by type of heating for the year 2010.

	Central heating [kg/TJ]	Apartement heating [kg/TJ]	Stove [kg/TJ]
Coal	4 206.0	4 206.0	3 705.0
Residual fuel oil < 1% S	45.0		
Residual fuel oil ≥ 1% S	15.0		
Heating oil	67.0	67.0	150.0
Kerosene	15.0		
LPG	37.0	37.0	
Natural gas	37.0	37.0	44.0
Solid biomass conventional	4 303.0	4 303.0	4 463.0 2 345.0(2)
Wood gasification	3 237.0(2)	3 107.0(2)	
Industrial waste	200.0(1)		

(1) *Default values for industrial boilers*

(2) *CO from new biomass heatings is calculated by means of ratio of NMVOC from new biomass heatings by NMVOC from conventional heatings*

Table 134: NFR 1 A 4 SO_2 emission factors by type of heating for the year 2010.

	Central heating [kg/TJ]	Apartement heating [kg/TJ]	Stove [kg/TJ]
Coal	543.0	543.0	340.0
Residual fuel oil < 1% S	90.0		
Residual fuel oil ≥ 1% S	398.0		
Heating oil	45.0	45.0	45.0
Kerosene	90.0	90.0	90.0
LPG	6.0(1)	6.0(1)	6.0(1)
Natural gas	NA	NA	NA
Solid biomass	11.0	11.0	11.0
Industrial waste	130.0(2)		

(1) *From (*LEUTGÖB *et al. 2003)*

(2) *Default value for industrial boilers (*BMWA *1990)*

Table 135: NFR 1 A 4 NH_3 emission factors for the year 2010.

	Central heating [kg/TJ]
Coal	0.01
Oil	2.68
Natural gas	1.00
Biomass	5.00
Industrial waste	0.02

3.1.6.3.1 Emission factors for heavy metals, POPs and PM used in NFR 1 A 4

In the following the emission factors for heavy metals, POPs and PM which are used in NFR 1 A 4 are described.

3.1.6.3.2 Emission factors for heavy metals used in NFR 1 A 4

Fuel Oil

For fuel oil the same emission factors as for 1 A 1 were used.

Coal and Biomass

NFR 1 A 4 c

For deciding on an emission factor for fuel wood results from (OBERNBERGER 1995), (LAUNHARDT et al. 2000) and (FTU 2000) were considered.

The emission factors for coal were derived from (CORINAIR 1995), Table 12, B112.

For mercury the emission factors for 1 A 4 c were also used for the other sub categories.

For lead the emission factors for 1 A 4 c were also used for 1 A 4 b Residential plants: central and apartment heating.

NFR 1 A 4 b

Emission factors for central and apartment heatings base on findings from (HARTMANN, BÖHM & MAIER 2000), (LAUNHARDT, HARTMANN, LINK & SCHMID 2000), (PFEIFFER, STRUSCHKA & BAUMBACH 2000), (STANZEL, JUNGMEIER & SPITZER 1995).

Results of measurements (SPITZER et al. 1998): show that the TSP emission factor for stoves are about 50% higher than the emission factor for central heatings – thus the Cd and Pb emission factor was also assumed to be 50% higher.

Table 136: HM emission factors for Sector 1 A 4 Other Sectors (Commercial and Residential).

	Cadmium EF [mg/GJ]	Mercury EF [mg/GJ]	Lead EF [mg/GJ]
1A4a Commercial/Institutional plants (020103) **1A4c i Plants in Agriculture/Forestry/Fishing (020302)**			
102A Hard coal 104A Hard coal briquettes 107A Coke oven coke	5.4	10.7	90
105A Brown coal 106A Brown coal briquettes	3.7	9.2	22
111A Fuel wood 116A Wood waste 113A Peat	7.0	1.9	23
1A4b Residential plants: central and apartment heating (020202)			
102A Hard coal 104A Hard coal briquettes 107A Coke oven coke	4.0	10.7	90
105A Brown coal 106A Brown coal briquettes	2.0	9.2	22
111A Fuel wood 116A Wood waste 113A Peat	3.0	1.9	23
1A4b Residential plants: stoves (020205)			
102A Hard coal 104A Hard coal briquettes 107A Coke oven coke	6.0	10.7	135
105A Brown coal 106A Brown coal briquettes	3.0	9.2	33
111A Fuel wood 116A Wood waste 113A Peat	4.5	1.9	35

3.1.6.4 Emission factors for POPs used in NFR 1 A 4

Residential plants

For residential plants the dioxin emission factors for coal and wood were taken from (HÜBNER & BOOS 2000); for heating oil a mean value from (PFEIFFER et al. 2000), (BOOS & HÜBNER 2000) and measurements by FTU (FTU 2000) was used. Combustion of waste in stoves was not considered, as no activity data was available.

HCB emission factors are taken from the national study (HÜBNER 2002) and based on field measurements from 15 solid fuel residential heatings with a capacity less than 50 kW using the standard methodology according to Ö-NORM EN-1948-1. The results show a high variation in flue gas concentrations without any correlation between type of heating (stove, boiler) or fuel (log wood, pellets, wood chips, coal).

The PAK emission factors are trimmed mean values from values given in (UBA BERLIN 1998), (SCHEIDL 1996), (ORTHOFER & VESSELY 1990), (SORGER 1993), (LAUNHARDT et al. 2000), (PFEIFFER et al. 2000) (LAUNHARDT et al. 1998), (STANZEL et al. 1995), (BAAS et al. 1995). However, it was not possible to determine different emission factors for stoves and central heating from the values given in the cited literature. Thus for solid fuels the same proportions given from the dioxin EFs, and for oil the proportions of carbon black given in (HÜBNER et al. 1996), was used. For natural gas it was assumed that the values given in literature are valid for stoves, and that values for central heating are assumed to be five times lower.

Commercial and Institutional plants and Plants in Agriculture/Forestry/Fishing

The same emission factors as used for central heating in the residential sector and for small (and medium) plants of category 1 A 2 were used (the share of the different size classes is based on expert judgement). The values given in the following Table are averaged values per fuel category.

As emission factors for heavy fuel oil and other oil products the same factors as for *1 A 2 Manufacturing and Construction* were used.

Table 137: POP emission factors for 1 A 4.

EF	PCDD/F [µg/GJ]	HCB [µg/GJ]	PAK4 [mg/GJ]
1A4a Commercial/Institutional plants (SNAP 020103)			
Coal:102A, 104A, 105A, 106A, 107A	0.24	180 160/190 180	25 24 4.5
203B Light fuel oil 203C Medium fuel oil	0.002	0.19	0.24
203D Heavy fuel oil	0.0009	0.12	0.24
204A Heating oil 206A Petroleum	0.0012	0.12	0.18
224A Other Oil Products	0.0017	0.14	0.011
301A Natural gas	0.0016	0.14	0.01
303A LPG 310A Landfill gas	0.0017	0.14	0.011 0.0032
309A Biogas 309B Sewage sludge gas	0.0006	0.072	0.0032
111A Wood (IEF 2010)	0.189	173	21.5
115A Industrial waste	0.3	250	26
116A Wood wastes	0.430	240	24
1A4c i Plants in Agriculture/Forestry/Fishing (SNAP 020302)			
Coal (102A, 104A, 105A, 106A, 107A)	0.24	180 190 180	24 25 4.5
203B Light fuel oil 204A Heating oil	0.0015	0.15	0.24
301A Natural gas 303A LPG	0.0025	0.25	0.04
111A Wood (IEF 2010)	0.226	351	51
116A Wood wastes	0.38	600	85
1A4b Residential plants: central and apartment heating (SNAP 020202)			
Coal102A, 105A, 106A, 107A	0.38	600	85 12
203B Light fuel oil 204A Heating oil	0.0015	0.15	
224A Other Oil Products	0.0017	0.14	0.011
301A Natural gas 303A LPG	0.0025	0.25	0.04
111A Wood, 116A Wood wastes			
Central heating (IEF 2010)	0.226	351	51
Apartment heating	0.38	600	85
1A4b Residential plants: stoves (SNAP 020205)			
Coal 102A, 104A, 105A, 106A, 107A	0.75	600	170 24
204A Heating oil	0.003	0.3	1.7
301A Natural gas	0.006	0.6	0.2
111A Wood 113A Peat 116A Wood wastes	0.75	600	170

3.1.6.5 Emission factors for PM used in NFR 1 A 4

As already described in Chapter 1.3 the emission inventories of PM for different years were prepared by contractors and incorporated into the inventory system afterwards.

Emission factors were taken from (WINIWARTER et al. 2001) and were used for all years, except for the emission factors from 2000 onwards for wood waste, where the use of pellets (TSP = 30 kg/TJ; PM10 = 27 kg/TJ) was considered (UMWELTBUNDESAMT 2006b).

As for the other pollutants, emission factors were distinguished for three types of heating devices: central heating, apartment heating, and stoves.

The shares of PM10 (90%) and PM2.5 (80%) were also taken from (WINIWARTER et al. 2001).

Table 138: PM emission factors for NFR 1 A 4.

	TSP Emission Factors [g/GJ]		
	Central heating	**Apartment heating**	**Stoves**
Gas			
301A, 303A, 309A, 309B and 310A	0.5	0.5	0.5
Coal			
102A, 104A and 107A	45	94	153
105A and 106A	50	94	153
Oil			
203B, 204A	3	3	3
203D	65	65	65
224A	0.5	0.5	--
Other Fuels			
111A, 113A and 116A	55	90	148

Table 139: PM emission factor for "wood waste and other" used in commercial, institutional or residential plants as well in stationary plants and other equipments in NFR 1 A 4.

	TSP IEF [g/GJ]			
116A	**1990**	**1995**	**2000**	**2010**
Central heating	55.00	55.00	52.06	39.45
Apartment heating	90.00	90.00	82.95	52.90
Stoves	148.00	148.00	134.14	75.04

Other PM sources

For the following sources it is assumed that particle sizes are equal or smaller than PM2.5.

Barbecue

For activity data 11 kt of char coal has been calculated from foreign trade statistics and producton data (Import 11 900 t, Export 1 900 t, Production 1 000 t). An emission factor of 2 237 g TSP/GJ char coal has been selected which is 69 347 g/t char coal assuming a calorific value of 31 GJ/t. This leads to 763 t PM/year for the whole time series.

Bonfire

It is assumed that one bonfire is sparked every year for each 5 000 rural inhabitants. This leads to 1 000 bonfires each year for all 5 Mio rural inhabitants. The average size of a fire is estimated to have 30 m³ of wood which is 10 m³ of solid wood. Assuming a heating value of 10 GJ/m³ wood and selecting an emission factor of 1 500 g/GJ (similar to open fire places, expert guess from literature) this leads to 150 kg PM for each fire and 150 t PM for each year.

Open fire pits

It is assumed that one open fire pit exists for each 2 500 inhabitants. Assuming 20 fires per year and fire pit this leads to 66 400 fires each year. Assuming 0.025 m³ of solid wood per fire which is 0.3 GJ and selecting an emission factor of 800 g/GJ (open fireplace, EPA 1998, Klimont et al. 2002) this leads to 240 g PM/fire and 16 t PM for each year.

3.1.7 NFR 1 A 4 c ii Off-road Vehicles and Other Machinery – soil abrasion

PM emissions from abrasion of offroad machinery in agriculture and forestry are estimated by means of machinery stock, average operating hours and an PM emission factor of 30 [g TSP/machine operating hour]. The share in TSP emissions is 45% for PM10 and 12% for PM2.5. The following Table 140 presents the parameters used for 2011 emission calculation. Emission factors are taken from (WINIWARTER et al. 2007). Activity data is consistent with activity data used for calculation of exhaust emissions.

Table 140: Agriculture offroad machinery parameters for the year 2011.

Machinery	Stock	Avg. operating hours/year	Off-Site operating hours
Tractors	419 453	162	12%
Trucks	15 968	121	12%
Harvesters	10 838	113	12%
Mowers	101 895	27	12%

3.1.8 QA/QC

Comparison with EPER and E-PRTR data

Comparison of emissions with reported 2004/2005 EPER and 2007-2011 E-PRTR data does not explicitely identify inconsistencies.

1 A 1 a

Activity data and GHG emissions are in general of high quality due to the needs of GHG calculation and CO_2-trading. The quality system which is well defined for GHG is basicly also applied to non-GHG but is not always fully documented in the inventory system. The following QA/QC procedures are performed depending on resource availability.

1 A 1 a LPS data gap filling (DKDB)

It has to be noted that emissions from *DKDB* are reported for heating periods from October year$_{(n)}$ to September year$_{(n+1)}$. Due to this and in case of other missing values emissions and fuel consumption for an inventory year are completed by taking the monthly values from the previous inventory year if available. In some cases either activity data or emission data is not complete and gap filling is performed by using other monthly emission ratios of that plant. For boilers with mixed fuel consumption a linear regression model (MS-Excel function "RGP") is sometimes used.

1 A 1 a LPS data validation (DKDB)

An outcome of the methodology as presented in Table 51 is the ratios of measured and calculated emissions by fuel type. Possible reasons for unexplainable ratios:

- Default emission factors are not appropriate because the group includes inhomogen boiler technologies.
- Changed technologies are not reflected.
- Boilers used for default emission factor derivation are not the ident with boilers considered in the inventory aproach.
- Emission declarations are not appropriate (fuel consumption is not consistent with emissions).

Activity data of large boilers and other large plants is checked with the national energy balance. For some fuels (coal, residual fuel oil, waste) and categories total national consumption is limited to a few boilers. In this case LPS consumption may be checked with data from *Statistik Austria* or with the spatial „Bundesländer" energy balance. In some cases published environmental reports which underly a QA/QC system like EMAS are used for validation purpose.

1 A 1 b Petroleum refining

Reported fuel consumption is checked with energy balance. Monthly data from *DKDB* provides emissions by boiler which is cross-checked with reported flue gas concentrations or mandatory limits.

3.1.9 Planned improvements

A project for space heating emission factors update by means of field measurements is currently planned by the Umweltbundesamt GmbH in cooperation with some federal states and the Austrian Federal Ministry of Economics and Labour. Due to the high need on resources it is not clear when data is available for inventory update. It is expected to decrease uncertainty of category 1 A 4 emissions significantly if emission factors are developed which are linked to statistical data more accurate. However, CO, NMVOC and TSP emissions of new residential biomass boilers should be updated according to already existing measurements. The current selected emission factors do not accurately consider the improved combustion efficiency of modern boilers.

3.2 Recalculations

Activity data has been updated with data from the new edition of the energy balance, affecting emissions of all pollutants.

The following methodological improvements have been implemented for the 2013 submission:

Update of activity data

Main revisions of the energy balance

> The main revisions affected the years 2009 and 2010 and minor revisions have been carried out for the year 2005. Solid biomass for power plants (1.A.1.a) was revised upwards by about 8 PJ and for wood processing industries (1.A.2.f) by about 4 PJ for the year 2010. For the years 2009 and 2010 about 3 to 4 PJ of natural gas from power plants, for the year 2010 about 3 PJ from other energy industries (1.A.1.c) and for the years 2009 to 2010 about 4 to 6 PJ of natural gas have been shifted to the subsector other sectors (1.A.4). Consumption by waste incineration plants (1.A.1.a) was revised upwards by about 1.6 PJ for the years 2009 and 2010.

1.A.4 Other sectors - stationary combustion

> The results of the household census 2010[111] for different types of heating devices per energy source in households have been included.

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[111] STATISTIK AUSTRIA (2012): Sonderauswertung des Mikrozensus 2010 (MZ 2010): Energieeinsatz der Haushalte. Statistik Austria im Auftrag des BMLFUW. Wien.

3.3 NFR 1 A Mobile Fuel Combustion Activities

3.3.1 General description

In this Chapter the methodology for estimating emissions of mobile sources in NFR 1 A 3 transport and mobile sources of NFR 1 A 2 f, NFR 1 A 4, NFR 1 A 5, is described.

NFR Category *1 A 3 Transport* comprises emissions from fuel combustion, abrasion of brake and tyre wear, and dust dispersion of dust by road traffic in the sub categories.

Table 141: NFR and SNAP categories of '1 A Mobile Fuel Combustion Activities'.

Activity	NFR Category	SNAP	
NFR 1 A 2 Manufacturing Industry and Combustion			
Industry, Mobile Machinery	**NFR 1 A 2 f 1**		
		0808	Other Mobile Sources and Machinery-Industry
NFR 1 A 3 Transport			
Civil Aviation	**NFR 1 A 3 a**		
● Civil Aviation	NFR 1 A 3 a		
● Civil Aviation (Domestic, LTO)	NFR 1 A 3 a ii)i)	080501	Domestic airport traffic (LTO cycles – < 1 000 m)
● International Aviation (LTO)	NFR 1 A 3 a i (i)	080503	International airport traffic (LTO cycles < 1 000 m)
Road Transportation	**NFR 1 A 3 b**		
● R.T., Passenger cars	NFR 1 A 3 b 1	0701	Passenger cars
● R.T., Light duty vehicles	NFR 1 A 3 b 2	0702	Light duty vehicles < 3.5 t
● R.T., Heavy duty vehicles	NFR 1 A 3 b 3	0703	Heavy duty vehicles > 3.5 t and buses
● R.T., Mopeds & Motorcycles	NFR 1 A 3 b 4	0704	Mopeds and Motorcycles < 50 cm³ 0705 Motorcycles > 50 cm³
● Gasoline evaporation from vehicles	NFR 1 A 3 b 5	0706	Gasoline evaporation from vehicles
● Automobile tyre and brake wear	NFR 1 A 3 b 6	0707	Automobile tyre and brake wear
Railways	**NFR 1 A 3 c**	0802	Other Mobile Sources and Machinery-Railways
Navigation	**NFR 1 A 3 d**	0803	Other Mobile Sources and Machinery-Inland waterways
Other mobile sources and machinery	**NFR 1 A 3 e**	0810	Other Mobile Sources and Machinery-Other off-road
NFR 1 A 4 Other Sectors			
● Residential	1 A 4 b	0809	Other Mobile Sources and Machinery-Household and gardening
● Agriculture/ Forestry/ Fisheries	1 A 4 c	0806	Other Mobile Sources and Machinery-Agriculture 0807Other Mobile Sources and Machinery-Forestry

Activity	NFR Category	SNAP	
NFR 1 A 5 Other			
	1 A 5 b	0801	Other Mobile Sources and Machinery-Military
International Bunkers			
Civil Aviation (Domestic, cruise)	I B Av 1	080502	Domestic cruise traffic (> 1 000 m)
International aviation (cruise)	I B Av 2	080504	International cruise traffic (> 1 000 m)

Completeness

Table 142 provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated. Table 141 provides an overview about NFR categories and the corresponding SNAP codes.

Table 142: Completeness of "1 A Mobile Fuel Combustion Activities".

NFR Category	NO_x	CO	NMVOC	SO_x	NH_3	TSP	PM10	PM2.5	Pb	Cd	Hg	DIOX	PAH	HCB
1 A 2 f Industry, Mobile Machinery	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 3 a Civil Aviation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NE	NE	NE
1 A 3 b Road Transportation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 3 c Railways	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 3 d National Navigation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 3 e ii Other mobile sources and machinery	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 4 b ii Household and gardening (mobile)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1 A 4 c ii Off-road Vehicles and Other Machinery	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1A 4 c iii National Fishing	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 A 5 a Other, Stationary (Including military)	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
1 A 5 b Other, Mobile (Including military)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
International Aviation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NE	NE	NE
International maritime Navigation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International inland waterways (Included in NEC totals only)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

3.3.2 NFR 1 A 3 a Civil Aviation

The category *1 A 3 a Civil Aviation* contains flights according to Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) for domestic aviation (national LTO – landing/take off) and for international aviation (LTO – landing/take off). Domestic cruise and international cruise is considered in *I B Av International Bunkers Aviation*. Military Aviation is allocated in *1 A 5* Other. As can be seen in Table 143 emissions from NFR 1 A 3 a Civil Aviation increased significantly over the period from 1990–2011 due to an increase of activity.

Table 143: Emissions of SO_2, NO_x and NMVOC from 1 A 3 a ii Civil Aviation 1990–2011.

Year	**SO_2**			**NO_x**			**NMVOC**		
	Total 1 A 3 a	**Domestic LTO**	**Int. LTO**	**Total 1 A 3 a**	**Domestic LTO**	**Int. LTO**	**Total 1 A 3 a**	**Domestic LTO**	**Int. LTO**
					[Gg]				
1990	0.033	0.004	0.029	0.41	0.04	0.37	0.20	0.07	0.14
1991	0.037	0.004	0.033	0.46	0.04	0.42	0.21	0.07	0.15
1992	0.042	0.005	0.037	0.52	0.04	0.48	0.23	0.07	0.16
1993	0.046	0.005	0.041	0.57	0.04	0.53	0.24	0.07	0.17
1994	0.050	0.005	0.045	0.63	0.05	0.58	0.25	0.07	0.18
1995	0.054	0.005	0.049	0.68	0.05	0.63	0.25	0.06	0.19
1996	0.058	0.006	0.052	0.73	0.05	0.67	0.29	0.07	0.22
1997	0.063	0.007	0.056	0.78	0.06	0.72	0.33	0.08	0.25
1998	0.067	0.008	0.059	0.83	0.07	0.76	0.38	0.10	0.28
1999	0.068	0.008	0.060	0.86	0.07	0.79	0.38	0.10	0.28
2000	0.074	0.007	0.067	0.86	0.07	0.79	0.38	0.08	0.29
2001	0.069	0.006	0.063	0.81	0.06	0.75	0.35	0.07	0.28
2002	0.080	0.006	0.074	1.00	0.06	0.94	0.41	0.08	0.33
2003	0.083	0.006	0.077	1.05	0.06	0.99	0.43	0.09	0.34
2004	0.099	0.006	0.092	1.26	0.07	1.19	0.49	0.09	0.40
2005	0.092	0.006	0.086	1.09	0.06	1.03	0.47	0.09	0.38
2006	0.092	0.007	0.085	1.07	0.08	0.99	0.47	0.10	0.37
2007	0.099	0.008	0.092	1.17	0.08	1.09	0.50	0.10	0.40
2008	0.102	0.008	0.093	1.19	0.08	1.11	0.52	0.11	0.41
2009	0.093	0.008	0.085	1.11	0.08	1.03	0.48	0.11	0.38
2010	0.095	0.007	0.088	1.14	0.07	1.06	0.49	0.10	0.39
2011	0.107	0.007	0.100	1.28	0.07	1.22	0.56	0.12	0.44
Trend 1990–2011	*225%*	*71%*	*248%*	*215%*	*88%*	*227%*	*174%*	*81%*	*221%*
Trend 2010–2011	*12%*	*-3%*	*14%*	*13%*	*-8%*	*14%*	*15%*	*22%*	*14%*

Table 144: Emissions of NH_3, CO and PM from 1 A 3 a ii Civil Aviation 1990–2011.

Year	**NH_3**			**CO**			**TSP=PM10=PM2.5**		
	Total 1 A 3 a	**Domestic LTO**	**Int. LTO**	**Total 1 A 3 a**	**Domestic LTO**	**Int. LTO**	**Total 1 A 3 a**	**Domestic LTO**	**Int. LTO**
	[Gg]						**[Mg]**		
1990	0.0003	0.0001	0.0002	2.47	2.05	0.42	35.06	3.83	31.23
1991	0.0003	0.0001	0.0002	2.55	2.11	0.44	NE	NE	NE
1992	0.0004	0.0001	0.0003	2.64	2.17	0.47	NE	NE	NE
1993	0.0004	0.0001	0.0003	2.73	2.24	0.49	NE	NE	NE
1994	0.0004	0.0001	0.0003	2.82	2.30	0.52	NE	NE	NE
1995	0.0004	0.0001	0.0003	2.39	1.85	0.54	58.13	5.14	53.00
1996	0.0005	0.0001	0.0004	2.41	1.80	0.61	NE	NE	NE
1997	0.0005	0.0001	0.0004	2.70	2.02	0.68	NE	NE	NE
1998	0.0005	0.0001	0.0004	2.94	2.19	0.75	NE	NE	NE
1999	0.0005	0.0001	0.0004	3.08	2.33	0.76	NE	NE	NE
2000	0.0006	0.0001	0.0005	2.67	1.69	0.98	79.14	6.92	72.22
2001	0.0005	0.0001	0.0004	2.53	1.53	0.99	74.26	5.71	68.55
2002	0.0006	0.0001	0.0005	3.02	1.95	1.07	86.16	6.01	80.15
2003	0.0006	0.0001	0.0005	3.22	2.12	1.11	89.42	5.91	83.51
2004	0.0007	0.0001	0.0006	3.31	1.97	1.34	105.91	6.29	99.62
2005	0.0007	0.0001	0.0006	3.41	2.27	1.14	98.88	6.06	92.82
2006	0.0007	0.0001	0.0006	3.68	2.35	1.33	99.10	7.15	91.95
2007	0.0008	0.0001	0.0006	3.84	2.35	1.49	106.72	7.29	99.43
2008	0.0008	0.0001	0.0006	3.96	2.43	1.53	109.12	8.06	101.05
2009	0.0007	0.0001	0.0006	4.08	2.69	1.39	99.94	7.49	92.45
2010	0.0007	0.0001	0.0006	3.84	2.41	1.44	102.05	7.12	94.93
2011	0.0009	0.0002	0.0007	5.28	3.58	1.70	114.39	6.44	107.95
Trend 1990–2011	*188%*	*74%*	*246%*	*114%*	*74%*	*309%*	*226%*	*68%*	*246%*
Trend 2010–2011	*17%*	*30%*	*14%*	*37%*	*49%*	*19%*	*12%*	*-10%*	*14%*

Table 145: Emissions of Cd, Hg and Pb from 1 A 3 a ii Civil Aviation 1990–2011.

Year	**Cd**			**Hg**			**Pb**		
	Total 1 A 3 a	**Domestic LTO**	**Int. LTO**	**Total 1 A 3 a**	**Domestic LTO**	**Int. LTO**	**Total 1 A 3 a**	**Domestic LTO**	**Int. LTO**
					[kg]				
1990	0.030	0.005	0.025	0.010	0.002	0.009	1 726.052	1 726.028	0.025
1991	0.034	0.005	0.029	0.012	0.002	0.010	1 778.687	1 778.658	0.029
1992	0.038	0.006	0.032	0.013	0.002	0.011	1 832.926	1 832.894	0.032
1993	0.041	0.006	0.036	0.014	0.002	0.012	1 888.818	1 888.783	0.036
1994	0.045	0.006	0.039	0.016	0.002	0.014	1 946.415	1 946.376	0.039
1995	0.048	0.006	0.042	0.017	0.002	0.015	0.056	0.014	0.042

Year	Cd			Hg			Pb		
	Total 1 A 3 a	Domestic LTO	Int. LTO	Total 1 A 3 a	Domestic LTO	Int. LTO	Total 1 A 3 a	Domestic LTO	Int. LTO
					[kg]				
1996	0.052	0.006	0.045	0.018	0.002	0.016	0.059	0.014	0.045
1997	0.055	0.007	0.048	0.019	0.003	0.017	0.064	0.016	0.048
1998	0.059	0.008	0.051	0.021	0.003	0.018	0.068	0.017	0.051
1999	0.060	0.008	0.052	0.021	0.003	0.018	0.070	0.018	0.052
2000	0.065	0.007	0.058	0.023	0.002	0.020	0.072	0.014	0.058
2001	0.061	0.006	0.055	0.021	0.002	0.019	0.067	0.012	0.055
2002	0.071	0.007	0.064	0.025	0.002	0.022	0.079	0.015	0.064
2003	0.073	0.007	0.067	0.026	0.002	0.023	0.082	0.016	0.067
2004	0.087	0.007	0.080	0.030	0.002	0.028	0.095	0.015	0.080
2005	0.081	0.007	0.074	0.028	0.002	0.026	0.091	0.017	0.074
2006	0.081	0.008	0.074	0.028	0.003	0.026	0.091	0.018	0.074
2007	0.088	0.008	0.080	0.031	0.003	0.028	0.097	0.018	0.080
2008	0.089	0.009	0.081	0.031	0.003	0.028	0.100	0.019	0.081
2009	0.082	0.008	0.074	0.029	0.003	0.026	0.094	0.020	0.074
2010	0.084	0.008	0.076	0.029	0.003	0.027	0.094	0.018	0.076
2011	0.095	0.008	0.086	0.033	0.003	0.030	0.110	0.024	0.086
Trend 1990–2011	*217%*	*71%*	*246%*	*217%*	*71%*	*246%*	*-99%*	*-99%*	*246%*
Trend 2010–2011	*13%*	*7%*	*14%*	*13%*	*7%*	*14%*	*17%*	*32%*	*14%*

3.3.2.1 Methodological Issues

IFR – Instrument Flight Rules

For the years 1990–1999 a country-specific methodology was applied. The calculations are based on a study commissioned by the Umweltbundesamt finished in 2002 (KALIVODA et al. 2002). This methodology is consistent with the very detailed CORINAIR Tier 3b methodology (advanced version based on (MEET 1999)): air traffic movement data[112] (flight distance and destination per aircraft type) and aircraft/engine performances data were used for the calculation.

For the years 2000–2011 the CORINAIR Tier 3a methodology was applied. Tier 3a takes into account average fuel consumption and emission data for LTO phases and various flight lengths, for an array of representative aircraft categories.

VFR – Visual Flight Rules

Fuel consumption for the years 2000–2008 was extrapolated from 1990–1999.

The emissions have been calculated with IEF´s from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

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[112] This data is also used for the split between national and international aviation.

Activity Data

Fuel consumptions for 1 A 3 a ii Civil Aviation presented in Table 146.

Table 146: Fuel consumptions 1 A 3 a ii Civil Aviation 1990–2011.

Year	Domestic LTO		International LTO
	Kerosene	Gasoline	Kerosene
	[GJ]	[GJ]	[GJ]
1990	334 492	108 453	1 249 174
1991	407 517	111 760	1 426 241
1992	480 543	115 167	1 603 306
1993	553 568	118 679	1 780 372
1994	626 593	122 298	1 957 438
1995	694 805	97 035	2 119 816
1996	781 429	93 461	2 270 470
1997	866 448	104 908	2 416 227
1998	951 467	112 941	2 561 984
1999	995 057	120 009	2 613 099
2000	835 212	88 295	2 888 661
2001	743 776	80 897	2 742 143
2002	751 029	103 464	3 206 172
2003	746 896	112 411	3 340 438
2004	779 660	104 149	3 984 939
2005	796 618	120 669	3 712 764
2006	861 635	124 167	3 678 073
2007	888 679	123 682	3 977 370
2008	844 968	127 232	4 042 043
2009	785 501	141 493	3 698 106
2010	747 237	126 611	3 797 030
2011	659 773	190 671	4 317 981
Trend 1990–2011	*97%*	*76%*	*246%*
Trend 2010–2011	*-12%*	*51%*	*14%*

Instrument Flight Rules (IFR) flights

For the years 1990-1999 fuel consumptions for the different transport modes IFR national LTO, IFR international LTO, IFR national cruise and IFR international cruise as obtained from the MEET model were summed up to a total fuel consumption figure. This value was compared with the total amount of kerosene sold in Austria of the national energy balance. As "fuel sold" is a robust value, the fuel consumption of IFR international cruise was adjusted so that the total fuel consumption of the calculations according to the MEET model is consistent with national fuel sales figures from the energy balance. The reason for choosing IFR international cruise for this adjustment is that this mode is assumed to have the highest uncertainty.

For the years 2000–2011 fuel consumption for the different transport modes IFR national LTO, IFR international LTO, IFR national cruise and IFR international cruise was calculated according to the CORINAIR Tier 3a method, with average consumption data per aircraft types and flight distances. The fuel consumption of IFR international cruise was adjusted as explained above.

The number of flight movements per aircraft type and airport (national and international) was obtained from special analyses by Statistik Austria (STATISTIK AUSTRIA 2008a for the years 2000-2007; 2009a; 2010a, 2011a; 2012a) and by Austro Control (AUSTRO CONTROL 2007 for the years 2000-2006; 2008; 2009; 2010; 2011; 2012). Moreover, for the calculation of passenger kilometres and ton kilometres input data was taken from the Austrian transport statistics (STATISTIK AUSTRIA 2013). The total amount of jet kerosene and gasoline was taken from the energy balance (STATISTIK AUSTRIA 2012c).

Visual Flight Rules (VFR) flights

Fuel consumption for the years 2000–2008 was extrapolated from 1990–1999.

The emissions have been calculated with IEF´s from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

Emission factors

Emission factors for NO_x, CO

IFR

For the years 1990–1999 emission estimates for fuel consumption, NO_x and CO were taken from an aviation study commissioned by the Umweltbundesamt (KALIVODA et al. 2002) the emission factors are aircraft/ engine specific.

For the years 2000–2010 the CORINAIR Tier 3a was applied. Tier 3a takes into account average fuel consumption and emission data for LTO phases and various flight lengths, for an array of representative aircraft categories.

VFR

For the years 1990–1999 emission estimates for fuel consumption, NO_x and CO were taken from an aviation study commissioned by the Umweltbundesamt (KALIVODA et al. 2002)

For the years 1999–2011 emissions of VFR flights have been calculated with IEF´s from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

Emission factors for NMVOC

IFR

For the years 1990–1999 NMVOC emissions for IFR flights have been calculated like NO_x (VOC emissions calculated with a country specific method, KALIVODA et al. 2002). According to the EMEP/CORINAIR Emission Inventory Guidebook (Version 2007) 90.4% of VOC of the LTO-IFR are assumed to be NMVOC. According to CORINAIR Guidebook no CH4 emissions during the cruise phase is emitted. That means total VOC emissions equals NMVOC emissions.

For the years 2000–2011 NMVOC emissions for IFR flights have been calculated in this way:

Total VOC emissions have been calculated with the implied emission factor for the year 1999 as obtained in the study (KALIVODA et al. 2002). According to the CORINAIR guidebook 90.4% of VOC of the LTO-IFR are assumed to be NMVOC.

VFR

For the years 1990–1999 emission estimates were taken from an aviation study commissioned by the Umweltbundesamt (KALIVODA et al. 2002)

For the years 1999–2011 NMVOC emissions of VFR flights have been calculated with an IEF from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

Emission factors for NH_3

IFR

For the years 1990–1999 NH_3 emissions for IFR flights have been calculated like NO_x (KALIVODA et al. 2002).

For the years 1999–2011 NH_3 emissions for IFR flights have been calculated with an IEF from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

VFR

For the years 1990–1999 emission estimates were taken from an aviation study commissioned by the Umweltbundesamt (KALIVODA et al. 2002).

For the years 1999–2011 NH_3 emissions of VFR flights have been calculated with an IEF from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

In Table 147 and Table 8 activities and IEF for Civil Aviation (domestic LTO + international LTO) are presented. Activity data of domestic and international LTO increased over the period from 1990–2011 by about 220%.

Table 147: Implied emission factors for SO_2, NO_x, NMVOC, NH_3 and CO as well as activities for 1 A 3 a ii Civil Aviation (domestic LTO + international LTO) 1990–2011.

Year	Activity	IEF SO_2	IEF NO_x	IEF NMVOC	IEF NH_3	IEF CO
	[PJ]			[g/GJ]		
1990	1 496	21.97	272.84	136.48	0.20	0.20
1991	1 687	22.06	274.23	127.25	0.19	0.19
1992	1 879	22.12	275.34	119.93	0.19	0.19
1993	2 070	22.17	276.24	113.97	0.19	0.19
1994	2 262	22.22	276.96	109.05	0.19	0.19
1995	2 409	22.56	281.91	101.78	0.18	0.18
1996	2 587	22.56	281.56	110.31	0.18	0.18
1997	2 774	22.54	280.67	119.72	0.18	0.18
1998	2 958	22.53	280.13	127.59	0.18	0.18
1999	3 023	22.56	283.88	124.82	0.18	0.18
2000	3 242	22.73	266.12	116.29	0.17	0.17

Year	Activity	IEF SO_2	IEF NO_x	IEF NMVOC	IEF NH_3	IEF CO
	[PJ]	[g/GJ]				
2001	3 040	22.74	265.19	115.38	0.17	0.17
2002	3 535	22.70	284.20	115.74	0.17	0.17
2003	3 673	22.69	285.99	115.94	0.17	0.17
2004	4 326	22.77	290.92	113.39	0.17	0.17
2005	4 059	22.70	269.34	115.32	0.17	0.17
2006	4 071	22.69	262.98	116.30	0.17	0.17
2007	4 375	22.72	267.03	115.33	0.17	0.17
2008	4 474	22.71	266.25	115.76	0.17	0.17
2009	4 119	22.63	269.19	117.73	0.18	0.18
2010	4 191	22.66	271.69	115.89	0.17	0.17
2011	4 739	22.52	270.79	118.20	0.18	0.18

Table 148: Implied emission factors for heavy metals and PM10 as well as activities for 1 A 3 a ii Civil Aviation (domestic LTO + international LTO) 1990–2011.

Year	Activity	IEF Cd	IEF Hg	IEF Pb	IEF PM10
	[PJ]	[g/GJ]			
1990	1 496	0.020	0.007	1 154.101	23 441
1991	1 687	0.020	0.007	1 054.353	-
1992	1 879	0.020	0.007	975.735	-
1993	2 070	0.020	0.007	912.418	-
1994	2 262	0.020	0.007	860.542	-
1995	2 409	0.020	0.007	0.023	24 134
1996	2 587	0.020	0.007	0.023	-
1997	2 774	0.020	0.007	0.023	-
1998	2 958	0.020	0.007	0.023	-
1999	3 023	0.020	0.007	0.023	-
2000	3 242	0.020	0.007	0.022	24 414
2001	3 040	0.020	0.007	0.022	24 428
2002	3 535	0.020	0.007	0.022	24 371
2003	3 673	0.020	0.007	0.022	24 342
2004	4 326	0.020	0.007	0.022	24 482
2005	4 059	0.020	0.007	0.022	24 361
2006	4 071	0.020	0.007	0.022	24 344
2007	4 375	0.020	0.007	0.022	24 392
2008	4 474	0.020	0.007	0.022	24 389
2009	4 119	0.020	0.007	0.023	24 262
2010	4 191	0.020	0.007	0.022	24 350
2011	4 739	0.020	0.007	0.023	24 135

3.3.2.2 Planned improvements

At current no relevant improvements are planned.

3.3.3 International Bunkers – Aviation

Emissions from aviation assigned to international bunkers include the transport modes domestic and international cruise traffic for IFR-flights.

Table 149: Emissions of SO_2, NO_x and NMVOC from International Bunkers (domestic + international cruise traffic) 1990–2011.

Year	SO_2			NO_x			NMVOC		
	Mem Av	**Mem Av a**	**Mem Av b**	**Mem Av**	**Mem Av a**	**Mem Av b**	**Mem Av**	**Mem Av a**	**Mem Av b**
	Aviation (cruise)	**Civil Aviation (Domestic, Cruise)**	**Civil Aviation (International, Cruise)**	**Aviation (cruise)**	**Civil Aviation (Domestic, Cruise)**	**Civil Aviation (International, Cruise)**	**Aviation (cruise)**	**Civil Aviation (Domestic, Cruise)**	**Civil Aviation (International, Cruise)**
					[Gg]				
1990	0.26	0.00	0.25	2.44	0.04	2.40	0.18	0.02	0.16
1991	0.29	0.01	0.28	2.76	0.06	2.70	0.20	0.02	0.19
1992	0.31	0.01	0.31	3.00	0.08	2.92	0.22	0.01	0.21
1993	0.33	0.01	0.2	3.18	0.10	3.08	0.24	0.01	0.23
1994	0.34	0.01	0.33	3.31	0.11	3.19	0.25	0.01	0.24
1995	0.38	0.01	0.37	3.73	0.13	3.60	0.29	0.01	0.28
1996	0.43	0.01	0.41	4.14	0.15	3.99	0.34	0.01	0.33
1997	0.44	0.01	0.43	4.29	0.17	4.13	0.37	0.02	0.35
1998	0.46	0.02	0.44	4.43	0.18	4.25	0.40	0.02	0.38
1999	0.45	0.02	0.43	4.33	0.19	4.13	0.39	0.02	0.37
2000	0.48	0.01	0.47	6.44	0.19	6.25	0.42	0.02	0.40
2001	0.47	0.01	0.46	6.32	0.18	6.14	0.41	0.02	0.39
2002	0.43	0.01	0.41	5.67	0.18	5.49	0.37	0.02	0.35
2003	0.40	0.01	0.38	5.21	0.18	5.03	0.34	0.02	0.33
2004	0.47	0.01	0.46	6.09	0.19	5.90	0.40	0.02	0.39
2005	0.55	0.01	0.54	6.99	0.20	6.79	0.47	0.02	0.45
2006	0.58	0.01	0.56	7.54	0.21	7.33	0.50	0.02	0.48
2007	0.61	0.01	0.60	7.99	0.21	7.78	0.53	0.02	0.51
2008	0.61	0.01	0.60	7.90	0.19	7.71	0.52	0.02	0.51
2009	0.53	0.01	0.52	6.86	0.18	6.69	0.45	0.01	0.44
2010	0.57	0.01	0.56	7.60	0.16	7.43	0.49	0.01	0.48
2011	0.60	0.01	0.59	7.98	0.15	7.83	0.51	0.01	0.50
Trend 1990–2011	*133%*	*119%*	*133%*	*227%*	*259%*	*226%*	*183%*	*-33%*	*207%*
Trend 2010–2011	*4%*	*-11%*	*5%*	*5%*	*-12%*	*5%*	*4%*	*-11%*	*5%*

Table 150: Emissions of NH3, CO and PM from International Bunkers (domestic + international cruise traffic) 1990–2011.

Year	NH_3			CO			TSP=PM10=PM2.5		
	Mem Av	**Mem Av a**	**Mem Av b**	**Mem Av**	**Mem Av a**	**Mem Av b**	**Mem Av**	**Mem Av a**	**Mem Av b**
	Aviation (cruise)	**Civil Aviation (Domestic, Cruise)**	**Civil Aviation (International, Cruise)**	**Aviation (cruise)**	**Civil Aviation (Domestic, Cruise)**	**Civil Aviation (Inter national, Cruise)**	**Aviation (cruise)**	**Civil Aviation (Domestic, Cruise)**	**Civil Aviation (Inter national, Cruise)**
				[Gg]				**[Mg]**	
1990	0.0018	0.0000	0.0017	0.49	0.06	0.43	280.26	4.91	275.35
1991	0.0020	0.0000	0.0019	0.55	0.05	0.49	NE	NE	NE
1992	0.0021	0.0001	0.0021	0.59	0.05	0.55	NE	NE	NE
1993	0.0023	0.0001	0.0022	0.63	0.04	0.59	NE	NE	NE
1994	0.0023	0.0001	0.0023	0.66	0.04	0.62	NE	NE	NE
1995	0.0026	0.0001	0.0025	0.75	0.03	0.72	415.75	12.57	403.17
1996	0.0029	0.0001	0.0028	0.84	0.04	0.80	NE	NE	NE
1997	0.0030	0.0001	0.0029	0.89	0.05	0.84	NE	NE	NE
1998	0.0031	0.0001	0.0030	0.93	0.05	0.87	NE	NE	NE
1999	0.0030	0.0001	0.0029	0.89	0.06	0.83	NE	NE	NE
2000	0.0033	0.0001	0.0032	0.80	0.06	0.74	524.22	14.27	509.96
2001	0.0032	0.0001	0.0031	0.78	0.05	0.72	511.55	13.17	498.38
2002	0.0029	0.0001	0.0028	0.66	0.05	0.61	462.02	13.13	448.89
2003	0.0027	0.0001	0.0026	0.65	0.05	0.59	428.45	13.16	415.29
2004	0.0032	0.0001	0.0031	0.73	0.05	0.68	506.13	13.57	492.56
2005	0.0037	0.0001	0.0036	0.91	0.05	0.86	594.34	14.28	580.06
2006	0.0039	0.0001	0.0038	0.92	0.05	0.86	626.32	14.83	611.50
2007	0.0042	0.0001	0.0041	0.96	0.05	0.90	662.94	15.36	647.58
2008	0.0042	0.0001	0.0041	0.96	0.04	0.91	661.59	13.50	648.08
2009	0.0036	0.0001	0.0035	0.82	0.04	0.78	570.25	12.64	557.61
2010	0.0039	0.0001	0.0038	0.87	0.04	0.84	621.71	12.00	609.71
2011	0.0041	0.0001	0.0040	0.86	0.03	0.83	648.28	10.72	637.56
Trend 1990–2011	*131%*	*118%*	*132%*	*77%*	*-42%*	*94%*	*131%*	*118%*	*132%*
Trend 2010–2011	*4%*	*-11%*	*5%*	*-1%*	*-11%*	*-1%*	*4%*	*-11%*	*5%*

Table 151: Emissions of Cd, Hg and Pb from International Bunkers (domestic + international cruise traffic) 1990–2011.

Year	Cd			Hg			Pb		
	Mem Av **Aviation (cruise)**	**Mem Av a** **Civil Aviation (Domestic, Cruise)**	**Mem Av b** **Civil Aviation (Intern ational, Cruise)**	**Mem Av** **Aviation (cruise)**	**Mem Av a** **Civil Aviation (Domestic, Cruise)**	**Mem Av b** **Civil Aviation (Inter national, Cruise)**	**Mem Av** **Aviation (cruise)**	**Mem Av a** **Civil Aviation (Domestic, Cruise)**	**Mem Av b** **Civil Aviation (Inter national, Cruise)**
					[kg]				
1990	0.224	0.004	0.220	0.078	0.001	0.077	0.224	0.004	0.220
1991	0.252	0.005	0.247	0.088	0.002	0.086	0.252	0.005	0.247
1992	0.273	0.006	0.266	0.095	0.002	0.093	0.273	0.006	0.266
1993	0.288	0.008	0.280	0.101	0.003	0.098	0.288	0.008	0.280
1994	0.298	0.009	0.289	0.104	0.003	0.101	0.298	0.009	0.289
1995	0.333	0.010	0.323	0.116	0.004	0.113	0.333	0.010	0.323
1996	0.370	0.011	0.359	0.129	0.004	0.126	0.370	0.011	0.359
1997	0.384	0.012	0.372	0.135	0.004	0.130	0.384	0.012	0.372
1998	0.397	0.013	0.384	0.139	0.005	0.134	0.397	0.013	0.384
1999	0.386	0.014	0.372	0.135	0.005	0.130	0.386	0.014	0.372
2000	0.419	0.011	0.408	0.147	0.004	0.143	0.419	0.011	0.408
2001	0.409	0.011	0.399	0.143	0.004	0.140	0.409	0.011	0.399
2002	0.370	0.011	0.359	0.129	0.004	0.126	0.370	0.011	0.359
2003	0.343	0.011	0.332	0.120	0.004	0.116	0.343	0.011	0.332
2004	0.405	0.011	0.394	0.142	0.004	0.138	0.405	0.011	0.394
2005	0.475	0.011	0.464	0.166	0.004	0.162	0.475	0.011	0.464
2006	0.501	0.012	0.489	0.175	0.004	0.171	0.501	0.012	0.489
2007	0.530	0.012	0.518	0.186	0.004	0.181	0.530	0.012	0.518
2008	0.529	0.011	0.518	0.185	0.004	0.181	0.529	0.011	0.518
2009	0.456	0.010	0.446	0.160	0.004	0.156	0.456	0.010	0.446
2010	0.497	0.010	0.488	0.174	0.003	0.171	0.497	0.010	0.488
2011	0.519	0.009	0.510	0.182	0.003	0.179	0.519	0.009	0.510
Trend 1990–2011	*131%*	*118%*	*132%*	*131%*	*118%*	*132%*	*131%*	*118%*	*132%*
Trend 2010–2011	*4%*	*-11%*	*5%*	*4%*	*-11%*	*5%*	*4%*	*-11%*	*5%*

Table 152: Activities for International Bunkers (domestic + international cruise traffic) 1990–2011.

Year	Liquid fuels	
	Domestic cruise [GJ]	**International cruise [GJ]**
1990	196 538	11 013 815
1991	258 524	12 330 283
1992	320 509	13 309 810
1993	382 495	13 998 446
1994	444 481	14 453 497
1995	502 981	16 126 964
1996	558 853	17 933 499
1997	613 563	18 602 699
1998	668 273	19 182 293
1999	705 037	18 583 080
2000	570 659	20 398 307
2001	526 852	19 935 057
2002	525 258	17 955 452
2003	526 256	16 611 794
2004	542 815	19 702 444
2005	571 237	23 202 501
2006	593 095	24 459 819
2007	614 404	25 903 263
2008	540 194	25 923 246
2009	505 621	22 304 269
2010	480 171	24 388 352
2011	428 972	25 502 323
Trend 1990–2011	*118%*	*132%*
Trend 2010–2011	*-11%*	*5%*

Table 153: Implied emission factors for SO_2, NO_x, NMVOC NH_3 and CO as well as activities and activities for International Bunkers (domestic + international cruise traffic) 1990–2011.

Year	Activity	IEF SO2	IEF NOx	IEF NMVOC	IEF NH3	IEF CO
	[TJ]	[g/GJ]				
1990	11 210	22.94	217.62	16.14	0.16	43.46
1991	12 589	22.94	218.85	16.22	0.16	43.43
1992	13 630	22.94	219.98	16.39	0.16	43.65
1993	14 381	22.94	221.06	16.59	0.16	44.00
1994	14 898	22.94	222.11	16.81	0.16	44.41
1995	16 630	23.10	224.55	17.17	0.16	45.09
1996	18 492	23.04	223.70	18.24	0.16	45.61
1997	19 216	23.04	223.51	19.18	0.16	46.18
1998	19 851	23.04	223.36	20.00	0.16	46.69

Year	Activity	IEF SO2	IEF NOx	IEF NMVOC	IEF NH3	IEF CO
	[TJ]	[g/GJ]				
1999	19 288	23.09	224.27	19.99	0.16	45.91
2000	20 969	23.09	307.33	19.84	0.16	38.00
2001	20 462	23.09	309.01	19.83	0.16	37.98
2002	18 481	23.09	306.90	19.85	0.16	35.88
2003	17 138	23.10	303.96	19.87	0.16	37.68
2004	20 245	23.10	300.92	19.84	0.16	36.13
2005	23 774	23.09	293.91	19.81	0.16	38.45
2006	25 053	23.09	300.90	19.81	0.16	36.62
2007	26 518	23.09	301.42	19.80	0.16	36.09
2008	26 463	23.09	298.42	19.78	0.16	36.17
2009	22 810	23.09	300.91	19.79	0.16	35.92
2010	24 869	23.06	305.44	19.74	0.16	35.16
2011	25 931	23.06	307.60	19.72	0.16	33.31

Table 154: Implied emission factors for Cd, Hg, Pb and PM10 as well as activities and activities for International Bunkers (domestic + international cruise traffic) 1990–2011.

Year	Activity	IEF Cd	IEF Hg	IEF Pb	IEF PM10
	[TJ]	[g/GJ]			
1990	11 210	0.020	0.007	0.007	23 441
1991	12 589	0.020	0.007	0.007	-
1992	13 630	0.020	0.007	0.007	-
1993	14 381	0.020	0.007	0.007	-
1994	14 898	0.020	0.007	0.007	-
1995	16 630	0.020	0.007	0.007	24 134
1996	18 492	0.020	0.007	0.007	-
1997	19 216	0.020	0.007	0.007	-
1998	19 851	0.020	0.007	0.007	-
1999	19 288	0.020	0.007	0.007	-
2000	20 969	0.020	0.007	0.007	24 414
2001	20 462	0.020	0.007	0.007	24 428
2002	18 481	0.020	0.007	0.007	24 371
2003	17 138	0.020	0.007	0.007	24 342
2004	20 245	0.020	0.007	0.007	24 482
2005	23 774	0.020	0.007	0.007	24 361
2006	25 053	0.020	0.007	0.007	24 344
2007	26 518	0.020	0.007	0.007	24 392
2008	26 463	0.020	0.007	0.007	24 389
2009	22 810	0.020	0.007	0.007	24 262
2010	24 869	0.020	0.007	0.007	24 350
2011	25 931	0.020	0.007	0.007	24 135

Emissions from International Bunkers have been calculated using the methodology and emission factors as described in Chapter 1 A 3 a Civil aviation.

3.3.4 International Bunkers – Navigation

Austria does not have any activities under International maritime navigation. Activities under International inland waterways are according to the NFR obligations, included in the national total.

3.3.5 NFR 1 A 3 b Road Transport

The sector includes emissions from passenger cars, light duty vehicles, heavy duty vehicles and busses, mopeds and motorcycles as well as gasoline evaporation from vehicles and automobile tyre and brake wear.

Emissions from road transportation are covered in this category.

Road Transport is the main emission source for NO_x, SO_2, NMVOC and NH_3 emissions of the transport sector. Up to 2005 especially classic air pollutants from road transport - NO_x and PM emissions – have increased mainly because of:

- steady increase of transport activity
- altered spatial structures: urban sprawl and centralisation
- changing demand structures in the industry: growing division of labour and flexible production methods (just-in-time production) cause the inventory being replaced by means of transport
- disproportionately existing infrastructure for motorized individual transport and further development
- changed lifestyle and mobility needs of the population
- fuel exports by - especially in comparison with Germany and Italy - cheap fuel prices in Austria

Technical improvements and a stricter legislation, however, led to a reduction of emissions per vehicle or per mileage respectively of mostly all other air pollutants. In 2011 emissions of most air pollutants were below 1990 levels.

From 2010 until 2011 national fuel consumption by road transport (gasoline, diesel and alternative fuels) declined by about 3 %, a decrease which was mainly due to increased fuel prices in Austria. Consequently, emissions have decreased from 2010 to 2011. In addition, specific consumption per vehicle kilometer also declined between 2010 and 2011.

Table 155: SO_2 Emissions from Category 1 A 3 b Road Transport differentiated by means of transportation 1990–2011.

			SO_2 [Gg]			
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**	**thereof fuel export**
1990	4.863	1.595	0.655	2.610	0.003	0.739
1991	5.485	1.863	0.712	2.908	0.003	1.022
1992	5.749	1.910	0.769	3.066	0.004	1.027
1993	6.115	1.994	0.810	3.307	0.004	1.144
1994	6.313	2.102	0.868	3.339	0.004	1.049

SO_2 [Gg]						
Year	Road Transportation	R.T., Passenger cars	R.T., Light duty vehicles	R.T., Heavy duty vehicles	R.T., Mopeds & Motorcycles	thereof fuel export
1995	5.723	1.956	0.771	2.992	0.004	0.970
1996	2.813	0.931	0.304	1.574	0.004	0.756
1997	2.440	0.900	0.296	1.241	0.003	0.451
1998	2.616	0.930	0.288	1.396	0.002	0.702
1999	2.344	0.861	0.279	1.202	0.002	0.519
2000	2.323	0.823	0.267	1.231	0.002	0.599
2001	2.397	0.845	0.258	1.293	0.001	0.728
2002	2.277	0.859	0.222	1.195	0.001	0.789
2003	2.275	0.892	0.206	1.176	0.001	0.859
2004	0.182	0.089	0.014	0.080	NA	0.065
2005	0.161	0.078	0.013	0.071	NA	0.058
2006	0.137	0.071	0.012	0.054	NA	0.045
2007	0.132	0.069	0.011	0.052	NA	0.043
2008	0.124	0.066	0.011	0.047	NA	0.036
2009	0.124	0.066	0.011	0.047	NA	0.037
2010	0.128	0.065	0.012	0.051	NA	0.041
2011	0.127	0.063	0.012	0.052	NA	0.038
Trend 1990–2011	*-97%*	*-96%*	*-98%*	*-98%*	*100%*	*-95%*
Trend 2010–2011	*-1%*	*-3%*	*0%*	*1%*	*-*	*-8%*

The introduction of stricter (lower) sulfur limits for fuels are the main driver for the immense reduction of SO_2 emissions. Sulphur-free fuels - such as those offered nationwide in Austria since 2006 - is a precondition for the use of advanced exhaust gas after treatment technologies.

Table 156: NO_x Emissions from Category 1 A 3 b Road Transport differentiated by means of transportation 1990–2011.

NO_x [Gg]						
Year	Road Transportation	R.T., Passenger cars	R.T., Light duty vehicles	R.T., Heavy duty vehicles	R.T., Mopeds & Motorcycles	thereof fuel export
1990	102.25	45.31	7.78	49.04	0.13	13.92
1991	108.46	46.71	7.75	53.86	0.14	20.34
1992	105.81	41.93	7.71	56.02	0.16	19.02
1993	105.74	38.22	7.60	59.75	0.17	20.50
1994	102.35	36.20	7.54	58.41	0.19	17.87
1995	101.50	34.13	7.32	59.83	0.22	19.07
1996	122.94	31.97	7.10	83.63	0.24	41.27
1997	108.04	31.22	6.93	69.61	0.27	26.80
1998	123.91	33.65	6.82	83.14	0.30	42.48
1999	116.64	32.56	6.76	76.99	0.33	34.70

NOx [Gg]						
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**	**thereof fuel export**
2000	125.55	33.12	6.71	85.36	0.35	42.87
2001	132.90	34.83	6.52	91.17	0.37	51.47
2002	141.47	39.45	6.31	95.32	0.40	60.60
2003	149.68	42.87	6.18	100.22	0.41	68.51
2004	148.63	44.10	6.09	98.02	0.42	68.08
2005	148.94	44.59	6.20	97.72	0.43	68.56
2006	134.39	43.36	6.24	84.36	0.44	55.22
2007	130.59	42.63	6.20	81.32	0.45	52.60
2008	119.71	39.58	5.85	73.83	0.46	45.20
2009	110.60	38.22	5.67	66.25	0.46	41.49
2010	112.53	36.95	5.65	69.46	0.47	45.64
2011	103.56	35.26	5.66	62.16	0.48	38.51
Trend 1990–2011	*1%*	*-22%*	*-27%*	*27%*	*258%*	*177%*
Trend 2010–2011	*-8%*	*-5%*	*0%*	*-11%*	*2%*	*-16%*

Main sources of NO_x emissions are diesel-powered passenger cars and heavy duty traffic. Both the number of diesel vehicles as well as their mileage increases. While NMVOC and CO emissions from road transport have been reduced significantly since 1990 due to emission limits for passenger cars and trucks laid down in European directives NO_x emissions, in contrast, increased up to 2005. Since then NO_x emissions have shown a decreasing trend, which is due to the advances in automotive technologies and the continuous fleet renewal. Specific NO_x emissions per vehicle kilometer declined too.

A substantial reduction, however, will be only realised with the introduction of specific nitrogen oxide catalysts for diesel vehicles - expected in passenger cars from 2014 onwards.

Table 157: NMVOC Emissions from Category 1 A 3 b Road Transport differentiated by means of transportation 1990–2011.

NMVOC [Gg]							
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**	**R.T., Gasoline evaporation**	**thereof fuel export**
1990	69.15	40.64	4.05	3.10	2.17	19.19	0.41
1991	71.69	44.72	3.84	3.17	2.07	17.90	3.63
1992	69.43	43.77	3.61	3.12	2.02	16.91	1.48
1993	67.24	43.03	3.38	3.09	1.97	15.77	0.13
1994	64.08	41.36	3.11	3.05	1.94	14.61	-1.54
1995	59.00	37.97	2.79	3.05	1.94	13.25	-1.66
1996	53.23	33.92	2.49	2.92	1.94	11.95	-2.17
1997	47.09	29.60	2.22	2.77	1.94	10.56	-2.81

NMVOC [Gg]							
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**	**R.T., Gasoline evaporation**	**thereof fuel export**
1998	44.87	29.25	1.97	2.63	1.97	9.04	0.15
1999	39.02	24.90	1.76	2.50	2.01	7.86	-0.96
2000	35.01	22.54	1.56	2.43	1.99	6.49	-0.07
2001	32.39	21.28	1.37	2.35	1.97	5.42	1.69
2002	31.26	21.35	1.19	2.30	1.96	4.46	4.36
2003	29.41	20.40	1.04	2.30	1.93	3.74	5.81
2004	26.62	18.24	0.90	2.33	1.90	3.26	5.82
2005	23.94	16.02	0.84	2.31	1.87	2.91	5.48
2006	20.79	13.22	0.74	2.32	1.85	2.66	4.38
2007	18.58	11.38	0.63	2.28	1.83	2.45	3.89
2008	16.05	9.28	0.49	2.14	1.82	2.32	2.85
2009	14.55	8.08	0.41	2.09	1.79	2.17	2.59
2010	13.60	7.34	0.35	2.10	1.76	2.06	2.53
2011	12.37	6.27	0.30	2.11	1.73	1.96	1.97
Trend 1990–2011	*-82%*	*-85%*	*-93%*	*-32%*	*-20%*	*-90%*	*382%*
Trend 2010–2011	*-9%*	*-15%*	*-13%*	*1%*	*-2%*	*-5%*	*-22%*

The introduction of more stringent emission standards for passenger cars according to the state of art (regulated catalytic converter) and the increased use of diesel vehicles in the passenger car sector are drivers for the decreasing trend of NMVOC emissions.

Table 158: NH_3 Emissions from Category 1 A 3 b Road Transport differentiated by means of transportation 1990–2011.

NH_3 [Gg]						
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**	thereof fuel export
1990	2.872	2.715	0.104	0.052	0.001	0.015
1991	4.395	4.216	0.123	0.055	0.001	0.365
1992	5.358	5.157	0.146	0.055	0.001	0.142
1993	6.202	5.978	0.167	0.057	0.001	-0.073
1994	6.914	6.693	0.165	0.056	0.001	-0.394
1995	6.726	6.511	0.158	0.057	0.001	-0.455
1996	6.165	5.943	0.149	0.072	0.001	-0.757
1997	5.645	5.447	0.139	0.059	0.001	-0.831
1998	5.677	5.483	0.129	0.064	0.001	-0.334
1999	4.961	4.785	0.119	0.056	0.001	-0.549
2000	4.528	4.359	0.108	0.059	0.001	-0.424
2001	4.267	4.107	0.097	0.062	0.001	-0.088

	NH$_3$ [Gg]					
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**	thereof fuel export
2002	4.269	4.117	0.087	0.064	0.001	0.483
2003	4.015	3.870	0.076	0.067	0.001	0.777
2004	3.510	3.374	0.067	0.068	0.001	0.787
2005	3.016	2.884	0.064	0.067	0.001	0.732
2006	2.494	2.375	0.058	0.060	0.001	0.616
2007	2.095	1.988	0.049	0.058	0.001	0.536
2008	1.651	1.559	0.037	0.053	0.001	0.334
2009	1.413	1.327	0.031	0.053	0.001	0.312
2010	1.244	1.159	0.026	0.058	0.001	0.279
2011	1.079	0.999	0.024	0.055	0.001	0.213
Trend 1990–2011	*-62%*	*-63%*	*-77%*	*5%*	*140%*	*1357%*
Trend 2010–2011	*-13%*	*-14%*	*-10%*	*-4%*	*0%*	*-24%*

Table 159: CO Emissions from Category 1 A 3 b Road Transport differentiated by means of transportation 1990–2011.

	CO [Gg]				
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**
1990	651.07	569.65	59.66	11.53	10.22
1991	706.30	627.39	56.11	12.39	10.41
1992	678.10	602.15	52.32	12.63	11.01
1993	656.71	583.30	48.53	13.23	11.65
1994	626.16	555.84	44.85	12.95	12.52
1995	576.60	509.42	40.26	13.24	13.69
1996	511.96	443.80	36.05	17.33	14.79
1997	456.78	394.82	32.00	14.08	15.89
1998	450.63	389.05	28.41	15.80	17.38
1999	393.90	335.75	25.13	14.11	18.90
2000	361.53	304.65	22.20	15.03	19.65
2001	344.32	288.61	19.35	16.01	20.35
2002	348.71	294.03	16.72	16.92	21.05
2003	337.78	284.09	14.36	18.02	21.31
2004	309.50	257.60	12.23	18.23	21.45
2005	281.82	230.54	11.37	18.32	21.60
2006	246.67	199.25	9.94	15.84	21.63
2007	219.05	174.34	8.14	14.84	21.72
2008	185.09	144.01	6.00	13.23	21.85

	CO [Gg]				
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**
2009	168.15	128.64	4.85	12.74	21.92
2010	154.26	114.85	4.00	13.43	21.99
2011	138.09	100.14	3.44	12.42	22.08
Trend 1990–2011	*-79%*	*-82%*	*-94%*	*8%*	*116%*
Trend 2010–2011	*-10%*	*-13%*	*-14%*	*-8%*	*0%*

Optimized combustion processes in the engine and the introduction of the catalytic converters are the main drivers for the decreasing trend of CO emissions.

Table 160: Cd Emissions from Category 1 A 3 b Road Transport differentiated by means of transportation 1990–2011.

	Cd [kg]					
Year	**Road Transportati on**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**	**R.T., Automobile road abrasion**
1990	60.12	2.33	0.35	0.89	0.01	56.54
1991	63.24	2.61	0.36	0.99	0.01	59.26
1992	65.24	2.54	0.37	1.04	0.02	61.27
1993	66.66	2.50	0.38	1.12	0.02	62.64
1994	69.19	2.48	0.39	1.13	0.02	65.17
1995	70.68	2.49	0.40	1.20	0.02	66.58
1996	72.68	2.40	0.40	1.69	0.02	68.15
1997	74.22	2.39	0.41	1.43	0.02	69.96
1998	76.83	2.61	0.43	1.73	0.02	72.03
1999	78.84	2.54	0.44	1.63	0.03	74.21
2000	81.22	2.58	0.45	1.82	0.03	76.34
2001	82.84	2.75	0.46	2.01	0.03	77.59
2002	84.91	3.14	0.46	2.18	0.03	79.10
2003	87.40	3.42	0.46	2.37	0.03	81.12
2004	88.97	3.54	0.47	2.39	0.03	82.54
2005	91.32	3.58	0.48	2.40	0.03	84.82
2006	93.90	3.53	0.48	2.08	0.03	87.78
2007	96.72	3.56	0.50	2.08	0.04	90.54
2008	95.93	3.33	0.48	1.95	0.04	90.14
2009	94.20	3.24	0.47	1.83	0.04	88.63
2010	96.29	3.20	0.48	2.07	0.04	90.50
2011	97.82	3.07	0.48	1.97	0.04	92.26
Trend 1990–2011	*63%*	*32%*	*37%*	*121%*	*164%*	*63%*
Trend 2010–2011	*2%*	*-4%*	*0%*	*-5%*	*3%*	*2%*

Table 161: Hg Emissions from Category 1 A 3 b Road Transport differentiated by means of transportation 1990–2011.

	Hg [kg]				
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**
1990	1.254	0.815	0.122	0.312	0.005
1991	1.393	0.915	0.126	0.346	0.005
1992	1.391	0.890	0.130	0.365	0.006
1993	1.404	0.874	0.132	0.392	0.006
1994	1.409	0.869	0.138	0.396	0.006
1995	1.436	0.871	0.140	0.419	0.007
1996	1.583	0.841	0.142	0.593	0.007
1997	1.491	0.837	0.145	0.502	0.008
1998	1.678	0.914	0.149	0.607	0.009
1999	1.623	0.890	0.154	0.569	0.009
2000	1.709	0.904	0.159	0.636	0.010
2001	1.836	0.964	0.160	0.702	0.010
2002	2.034	1.100	0.160	0.764	0.011
2003	2.200	1.198	0.162	0.830	0.011
2004	2.250	1.237	0.164	0.837	0.011
2005	2.274	1.253	0.168	0.841	0.012
2006	2.144	1.235	0.170	0.727	0.012
2007	2.160	1.246	0.174	0.727	0.012
2008	2.029	1.165	0.170	0.681	0.013
2009	1.952	1.134	0.164	0.641	0.013
2010	2.025	1.120	0.167	0.725	0.013
2011	1.944	1.074	0.167	0.690	0.014
Trend 1990–2011	*55%*	*32%*	*37%*	*121%*	*164%*
Trend 2010–2011	*-4%*	*-4%*	*0%*	*-5%*	*3%*

Table 162: Pb Emissions from Category 1 A 3 b Road Transport differentiated by means of transportation 1990–2011.

	Pb [kg]				
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**
1990	165 464.4	146 935.1	14 664.7	2 422.5	1 442.1
1991	131 903.7	117 243.1	11 391.7	2 061.5	1 207.5
1992	88 468.6	77 535.9	8 377.9	1 555.9	998.8
1993	56 342.8	48 837.8	5 666.7	1 072.7	765.6
1994	33 306.2	28 829.4	3 344.7	621.2	510.9

	Pb [kg]				
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**
1995	12.1	9.9	0.8	1.3	0.1
1996	11.9	9.3	0.8	1.8	0.1
1997	11.3	8.9	0.8	1.5	0.1
1998	12.1	9.5	0.8	1.8	0.1
1999	11.5	8.9	0.7	1.7	0.1
2000	11.5	8.7	0.7	1.9	0.1
2001	11.9	9.0	0.7	2.0	0.1
2002	13.0	9.9	0.7	2.2	0.2
2003	13.6	10.4	0.7	2.4	0.2
2004	13.5	10.3	0.6	2.4	0.2
2005	13.4	10.1	0.7	2.4	0.2
2006	12.8	9.9	0.7	2.1	0.2
2007	12.7	9.8	0.6	2.1	0.2
2008	11.7	8.9	0.6	2.0	0.2
2009	11.3	8.7	0.6	1.8	0.2
2010	11.4	8.6	0.6	2.1	0.2
2011	11.0	8.3	0.6	2.0	0.2
Trend 1990–2011	*-99%*	*-99%*	*-99%*	*-99%*	*-99%*
Trend 2010–2011	*-4%*	*-4%*	*-1%*	*-5%*	*3%*

By the conditions laid down in European directives emission limits for cars and trucks as well as more stringent quality requirements for fuels lead to almost completely reduced lead emissions from the transport.

Table 163: PAH Emissions from Category 1 A 3 b Road Transport differentiated by means of transportation 1990–2011.

	PAH [kg]				
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**
1990	908	500	104	284	20
1991	953	508	108	315	21
1992	919	452	112	332	23
1993	907	411	115	358	24
1994	895	388	120	361	26
1995	909	376	122	382	29
1996	1 059	362	124	541	31
1997	982	362	128	458	34
1998	1 119	396	132	554	37

	PAH [kg]				
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**
1999	1 091	394	137	520	41
2000	1 176	411	141	580	43
2001	1 282	453	143	641	45
2002	1 424	536	143	698	47
2003	1 561	610	145	758	48
2004	1 617	655	148	765	49
2005	1 674	692	153	779	50
2006	1 620	708	160	699	53
2007	1 660	737	166	703	54
2008	1 608	726	164	664	55
2009	1 575	721	162	637	55
2010	1 649	712	163	716	57
2011	1 589	683	164	683	59
Trend 1990–2011	*75%*	*37%*	*58%*	*141%*	*190%*
Trend 2010–2011	*-4%*	*-4%*	*1%*	*-5%*	*4%*

From 1990 onwards, PAH emissions increased sharply as a function of fuel consumption. A reduction potential results in the future by reducing the soot emissions of diesel-powered vehicles because the PAHs are mostly attached to the microparticles.

Table 164: Dioxin Emissions from Category 1 A 3 b Road Transport differentiated by means of transportation 1990–2011.

	Dioxin [g]					
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**	**R.T., Gasoline evaporation**
1990	3.895	3.265	0.335	0.292	0.002	IE
1991	3.761	3.120	0.317	0.321	0.002	IE
1992	3.192	2.557	0.299	0.334	0.002	IE
1993	2.727	2.091	0.280	0.353	0.003	IE
1994	2.352	1.728	0.268	0.353	0.003	IE
1995	2.053	1.433	0.249	0.368	0.003	IE
1996	1.888	1.150	0.233	0.502	0.003	IE
1997	1.594	0.946	0.217	0.427	0.003	IE
1998	1.576	0.864	0.202	0.507	0.004	IE
1999	1.361	0.695	0.188	0.474	0.004	IE
2000	1.293	0.591	0.175	0.524	0.004	IE
2001	1.277	0.540	0.159	0.573	0.004	IE

	Dioxin [g]					
Year	Road Transportation	R.T., Passenger cars	R.T., Light duty vehicles	R.T., Heavy duty vehicles	R.T., Mopeds & Motorcycles	R.T., Gasoline evaporation
2002	1.317	0.550	0.144	0.619	0.005	IE
2003	1.345	0.541	0.131	0.669	0.005	IE
2004	1.299	0.503	0.119	0.673	0.005	IE
2005	1.281	0.476	0.118	0.682	0.005	IE
2006	1.182	0.454	0.112	0.612	0.005	IE
2007	1.152	0.435	0.098	0.613	0.005	IE
2008	1.056	0.394	0.079	0.577	0.005	IE
2009	0.999	0.370	0.071	0.552	0.005	IE
2010	1.067	0.377	0.065	0.619	0.006	IE
2011	1.012	0.353	0.063	0.591	0.006	IE
Trend 1990–2011	*-74%*	*-89%*	*-81%*	*102%*	*158%*	
Trend 2010–2011	*-5%*	*-7%*	*-4%*	*-5%*	*3%*	

Table 165: HCB Emissions from Category 1 A 3 b Road Transport differentiated by means of transportation 1990–2011.

	HCB [g]				
Year	Road Transportation	R.T., Passenger cars	R.T., Light duty vehicles	R.T., Heavy duty vehicles	R.T., Mopeds & Motorcycles
1990	80.230	67.265	6.895	6.025	0.046
1991	77.478	64.273	6.535	6.622	0.047
1992	65.754	52.669	6.155	6.880	0.049
1993	56.172	43.069	5.769	7.281	0.052
1994	48.448	35.597	5.520	7.275	0.056
1995	42.299	29.524	5.136	7.578	0.061
1996	38.892	23.688	4.790	10.348	0.066
1997	32.827	19.491	4.461	8.804	0.070
1998	32.476	17.802	4.163	10.434	0.077
1999	28.044	14.322	3.881	9.757	0.084
2000	26.644	12.169	3.599	10.790	0.087
2001	26.309	11.121	3.284	11.814	0.091
2002	27.136	11.321	2.971	12.750	0.094
2003	27.712	11.147	2.694	13.774	0.097
2004	26.756	10.355	2.444	13.858	0.099
2005	26.387	9.816	2.424	14.046	0.101
2006	24.353	9.344	2.305	12.598	0.106
2007	23.727	8.967	2.026	12.625	0.109
2008	21.747	8.110	1.636	11.891	0.111
2009	20.573	7.617	1.469	11.375	0.111

	HCB [g]				
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**
2010	21.987	7.775	1.339	12.758	0.115
2011	20.839	7.266	1.288	12.167	0.118
Trend 1990–2011	*-74%*	*-89%*	*-81%*	*102%*	*158%*
Trend 2010–2011	*-5%*	*-7%*	*-4%*	*-5%*	*3%*

Table 166: PM Emissions from Category 1 A 3 b Road Transport differentiated by means of transportation 1990–2011.

	TSP = PM10 = PM2.5 [Mg]				
Year	**Road Transportation**	**R.T., Passenger cars**	**R.T., Light duty vehicles**	**R.T., Heavy duty vehicles**	**R.T., Mopeds & Motorcycles**
1990	9 851.24	682	401	1 923	NA
1995	12 255.89	1 178	544	2 433	NA
2000	13 637.54	1 749	571	2 308	NA
2001	13 899.26	1 842	551	2 366	NA
2002	14 322.75	2 057	525	2 389	NA
2003	14 748.68	2 214	506	2 452	NA
2004	14 851.40	2 224	479	2 353	NA
2005	14 973.56	2 227	471	2 313	NA
2006	14 644.18	2 140	457	1 883	NA
2007	14 465.16	2 050	438	1 642	NA
2008	13 907.74	1 836	400	1 361	NA
2009	13 397.00	1 673	349	1 211	NA
2010	13 264.06	1 487	309	1 178	NA
2011	13 041.41	1 283	271	1 002	NA
Trend 1990–2011	*32%*	*88%*	*-32%*	*-48%*	
Trend 2010–2011	*-2%*	*-14%*	*-12%*	*-15%*	

The reduction of PM emissions since 2005 is due to improvements in the drive and exhaust gas after treatment technologies and equipment with particulate filter systems in the NOVA control (fuel consumption based taxation for passenger cars in Austria).

Table 167: PM Emissions from Category 1 A 3 b Road Transport differentiated by means of transportation 1990–2011.

	TSP [Mg]		**PM10 [Mg]**		**PM2.5 [Mg]**	
Year	**R.T., Automobile tyre and break wear**	**R.T., Automobile road abrasion**	**R.T., Automobile tyre and break wear**	**R.T., Automobile road abrasion**	**R.T., Automobile tyre and break wear**	**R.T., Automobile road abrasion**
1990	IE	6 846	IE	2 282	IE	685
1995	IE	8 100	IE	2 700	IE	810
2000	IE	9 009	IE	3 003	IE	901
2001	IE	9 140	IE	3 047	IE	914
2002	IE	9 351	IE	3 117	IE	935
2003	IE	9 577	IE	3 192	IE	958
2004	IE	9 796	IE	3 265	IE	980
2005	IE	9 963	IE	3 321	IE	996
2006	IE	10 164	IE	3 388	IE	1 016
2007	IE	10 334	IE	3 445	IE	1 033
2008	IE	10 310	IE	3 437	IE	1 031
2009	IE	10 165	IE	3 388	IE	1 016
2010	IE	10 290	IE	3 430	IE	1 029
2011	IE	10 485	IE	3 495	IE	1 049
Trend 1990–2011	*53%*		*53%*		*53%*	
Trend 2010–2011	*2%*		*2%*		*2%*	

PM emissions from automobile tyre and break wear are increasing as a function of travelled vehicles kilometres which have shown an increasing trend since 1990.

3.3.5.1 Methodological Issues

Mobile combustion is differentiated into the categories passenger cars, light duty vehicles, heavy duty vehicles and buses, mopeds and motorcycles. Calculations of emissions from 1 A 3 b are based on the GLOBEMI model (HAUSBERGER 1998; HAUSBERGER & SCHWINGSHACKL 2012).

The program calculates vehicle mileages, passenger-km, ton-km, fuel consumption, exhaust gas emissions, evaporative emissions and suspended PM10 of the road traffic. The balances use the vehicle stock and functions of the km driven per vehicle and year to assess the total traffic volume of each vehicle category.

Model input is:

1) vehicle stock of each category split into layers according to the propulsion system (SI.CI...). cylinder capacity classes or vehicle mass;
2) emission factors of the vehicles according to the year of first registration and the layers from 1);
3) passengers per vehicle and tons payload per vehicle;

4) Optional either
   a) the total gasoline and diesel consumption of the area under consideration,
   b) the average km per vehicle and year.

Following data is calculated:

a) km driven per vehicle layer and year or total fuel consumption;
b) total vehicle mileages;
c) total passenger-km and ton-km;
d) specific emission values for the vehicle fleets [g/km], [g/t-km], [g/pass-km];
e) total emissions and energy consumption of the traffic (Fuel consumption (fc), CO, HC, NO_x, particulate matter (PM), CO_2, SO_2 and several unregulated pollutants among them CH_4 and N_2O).

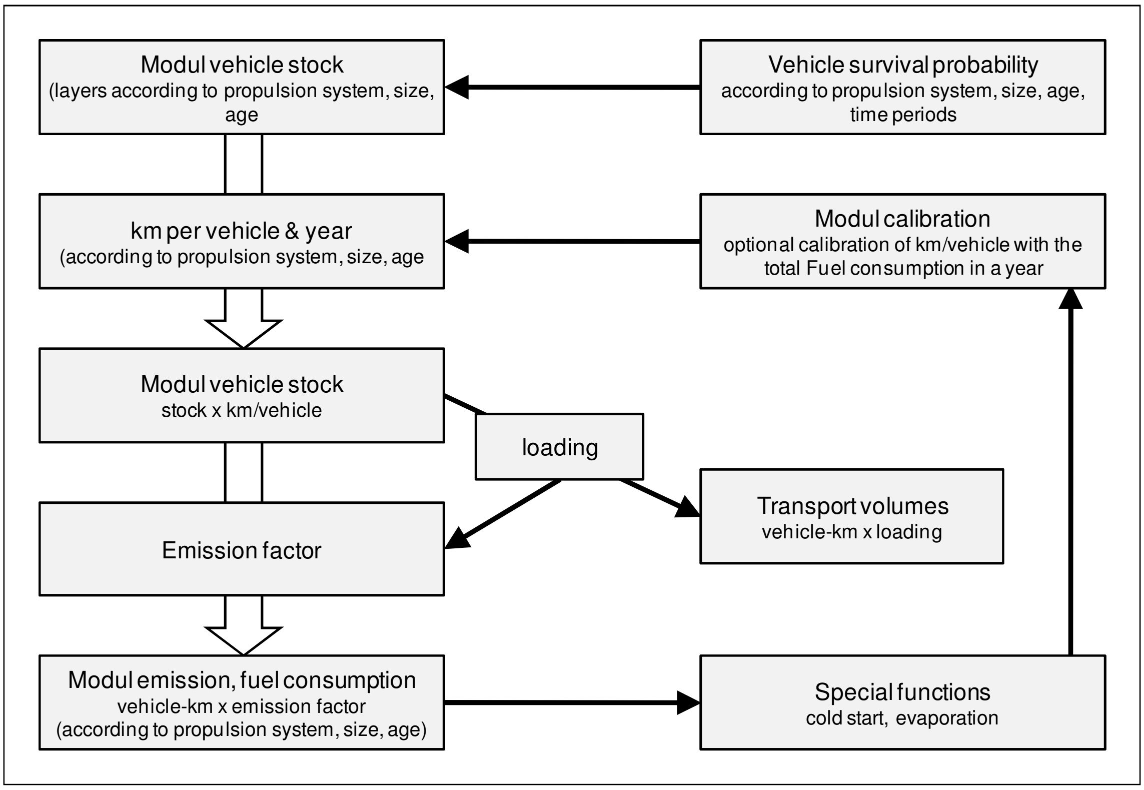

Figure 24: Schematic picture of the model GLOBEMI.

The calculation is done according to the following method for each year:

(1) Assessment of the vehicle stock split into layers according to the propulsion system. Cylinder capacity classes (or vehicle mass for HDV) and year of first registration using the vehicle survival probabilities and the vehicle stock of the year before.

$$stock_{Jg_i,\text{yeari}} = stock_{Jg_i,\text{yeari}-1} \times \text{survivalprobability}_{Jg_i}$$

(2) Assessment of the km per vehicle for each vehicle layer using age and size dependent functions of the average mileage driven. If option switched on, iterative adaptation of the km per vehicle to meet the total fuel consumption targets.

(3) Calculation of the total mileage of each emission category (e.g. passenger car diesel, <1 500ccm, EURO 3)

$$\text{total mileage}_{E_i} = \sum_{Jg=\text{start.}}^{\text{end}} (\text{stock}_{Jg,\text{year i}} \times \text{km/vehicle}_{Jg_i,\text{year i}})$$

(4) Calculation of the total fuel consumption and emissions of each emission category

$$\text{Emission}_{Ei} = \text{total mileage}_{Ei} \times \text{emission factor}_{Kj,\, Ei}$$

(5) Calculation of the total fuel consumption and emissions of each vehicle category

$$\text{Emission}_{\text{veh.category}} = \sum_{E_i=1}^{end} \text{Emission}_{E_i}$$

(6) Calculation of the total passenger-km and ton-km

$$\text{transportvolumes}_{\text{veh.category}} = \sum_{E_i=1}^{end} (\text{vehiclemileage}_{E_i} \times \text{loading}_{E_i})$$

(7) Summation over all vehicle categories

with

Jgi Index for a vehicle layer (defined size class. propulsion type. year of first registration)

Ei Index for vehicles within a emission category (defined size class. propulsion type and exhaust certification level)

3.3.5.2 Emission factors

Emission factors used for GLOBEMI are based on a representative number of vehicles and engines measured in real-world driving situations taken from the "Handbook of Emission Factors" (HBEFA) Version 2.1 (Hausberger & Keller et al. 1998) and on ARTEMIS measurements (basically for passenger cars, light duty vehicles and motorcycles) which are taken into account in HBEFA.

3.3.5.3 Activity data

Bottom up Methodology - fuel consumed

Energy consumption and emissions of the different vehicle categories are calculated by multiplying the yearly road performance per vehicle category (km/vehicle and year) by the specific energy use (g/km) and by the emission factors in g/km (Model: GLOBEMI).

GLOBEMI also models the road performance and emissions per vehicle size, age and motor type based on dynamic vehicle specific drop out- and road performance functions.

The total annual road performance (millage driven per year) in Austria which is used in GLOBEMI is taken from the national traffic model (VMOe (Verkehrs-Mengenmodell-Oesterreich – Austrian National Transport Model, Ministry of Transport, BMVIT, not published).

VMOe is a network-based, multimodal transport model covering passenger and freight transport. It is mainly used for forecasts and infrastructure assessment. Transport volumes for road are based on official background statistics relevant for travel and freight transport demand. These statistics include traffic counting information as well as average vehicle road performance (supplied by the Austrian automobile clubs throughout the annual vehicle inspection system), population data, motorisation rates, vehicle fleet sizes, economic and income development statistics. VMOe covers traffic movements between "transport zones" (the Austrian communities) and estimates the traffic generated by movements within the zones. This covers the total traffic within Austria driven by Austrian and foreign vehicles. The resulting mileages are used to calculate the total fuel consumption (and emissions based on fuel consumed) of traffic within Austria.

Top down Methodology – Fuel sold

Based on the GLOBEMI model fuel consumption and emissions for national road transport are calculated with a bottom-up approach. Calculated fuel consumption of road transport is then summed up with calculated fuel consumption of off road traffic and is compared with national total fuel sold.

The difference between the fuel consumption calculated in the bottom up methodology for road traffic plus off-road transport within Austria and total fuel sales in Austria (obtained from national statistics; STATISTIK AUSTRIA 2012c) is allocated to fuel export (fuel sold in Austria but consumed abroad).

Fuel export

Since the end of the nineties an increasing discrepancy between the total Austrian fuel sales and the computed domestic fuel consumption became apparent. From 2003 onward this gap accounts for roughly 30 percent of the total fuel sales. A possible explanation of this discrepancy is the "fuel export in the vehicle tank" – due to the relatively low fuel prices in Austria (in comparison to the neighboring countries). Meaning that to a greater extent fuel is filled up in Austria and consumed abroad. This assumption is underpinned by a national study (MOLITOR et al. 2004; MOLITOR et al. 2009).

Table 168: Activity data from Category 1 A 3 b Road Transport differentiated by fuel type 1990–2011.

	Fuel consumption (based on fuel sold) [TJ]					
Year	**Total**	**Gasoline**	**Diesel oil**	**LPG**	**Gaseous**	**Biomass**
1990	179 598	106 756	72 427	415	NO	NO
1991	199 445	117 101	81 916	428	NO	NO
1992	199 136	111 959	86 732	445	NO	NO
1993	201 044	107 394	93 199	452	NO	NO
1994	201 717	103 543	97 712	463	NO	NO
1995	205 667	100 008	105 163	496	NO	NO
1996	226 883	92 491	133 720	672	NO	NO

	Fuel consumption (based on fuel sold) [TJ]					
Year	**Total**	**Gasoline**	**Diesel oil**	**LPG**	**Gaseous**	**Biomass**
1997	213 603	87 672	125 399	532	NO	NO
1998	240 373	91 722	148 058	592	NO	NO
1999	232 410	85 245	146 546	620	NO	NO
2000	244 746	82 350	161 726	670	NO	NO
2001	263 019	82 980	179 319	720	NO	NO
2002	291 575	89 271	201 323	982	NO	NO
2003	315 419	91 279	223 011	1 129	NO	NO
2004	322 417	88 802	232 651	945	20	NO
2005	329 172	86 053	238 808	974	21	3 316
2006	318 950	83 988	222 249	1 002	21	11 690
2007	323 696	81 936	226 682	965	104	14 008
2008	308 460	73 479	216 337	1 000	189	17 455
2009	301 836	71 464	207 351	978	212	21 832
2010	312 678	70 504	218 768	1 559	213	21 633
2011	300 985	67 864	209 827	1 537	224	21 532
Trend 1990–2011	*68%*	*-36%*	*190%*	*270%*		
Trend 2010–2011	*-4%*	*-4%*	*-4%*	*-1%*	*5%*	*>0%*

The following tables present the IEF.

Table 169: Implied emission factors for NEC gases and CO and activities for 1 A 3 b Road Transport 1990–2011.

Year	**Activity**	**IEF SO_2**	**IEF NO_x**	**IEF NMVOC**	**IEF NH_3**	**IEF CO**
	[PJ]			**[t/PJ]**		
1990	179.60	27.08	569.34	385.01	15.99	3625.16
1991	199.45	27.50	543.82	359.47	22.03	3541.31
1992	199.14	28.87	531.36	348.66	26.91	3405.24
1993	201.04	30.42	525.97	334.47	30.85	3266.47
1994	201.72	31.30	507.38	317.66	34.28	3104.14
1995	205.67	27.82	493.53	286.85	32.70	2803.54
1996	226.88	12.40	541.84	234.61	27.17	2256.51
1997	213.60	11.42	505.78	220.46	26.43	2138.45
1998	240.37	10.88	515.51	186.67	23.62	1874.73
1999	232.41	10.09	501.86	167.90	21.34	1694.83
2000	244.75	9.49	512.97	143.04	18.50	1477.17
2001	263.02	9.11	505.27	123.14	16.22	1309.10
2002	291.58	7.81	485.20	107.21	14.64	1195.97
2003	315.42	7.21	474.55	93.25	12.73	1070.88
2004	322.42	0.57	460.99	82.57	10.89	959.95

Year	Activity	IEF SO_2	IEF NO_x	IEF NMVOC	IEF NH_3	IEF CO
	[PJ]			[t/PJ]		
2005	329.17	0.49	452.47	72.74	9.16	856.16
2006	318.95	0.43	421.36	65.20	7.82	773.37
2007	323.70	0.41	403.44	57.39	6.47	676.72
2008	308.46	0.40	388.08	52.03	5.35	600.06
2009	301.84	0.41	366.44	48.19	4.68	557.08
2010	312.68	0.41	359.90	43.51	3.98	493.36
2011	300.99	0.42	344.07	41.10	3.59	458.79

Table 170: Implied emission factors for heavy metals and POPs as well as activities for 1 A 3 b Road Transport 1990–2011.

Year	Activity	IEF Cd	IEF Hg	IEF Pb	IEF PAH	IEF Diox	IEF HCB
	[PJ]			[kg/PJ]			
1990	179.60	0.335	0.007	921.302	5.054	0.022	4.337
1991	199.45	0.317	0.007	661.353	4.777	0.019	3.772
1992	199.14	0.328	0.007	444.263	4.615	0.016	3.206
1993	201.04	0.332	0.007	280.250	4.510	0.014	2.713
1994	201.72	0.343	0.007	165.113	4.435	0.012	2.332
1995	205.67	0.344	0.007	0.059	4.419	0.010	1.997
1996	226.88	0.320	0.007	0.053	4.666	0.008	1.664
1997	213.60	0.347	0.007	0.053	4.597	0.007	1.492
1998	240.37	0.320	0.007	0.050	4.657	0.007	1.312
1999	232.41	0.339	0.007	0.049	4.694	0.006	1.172
2000	244.75	0.332	0.007	0.047	4.803	0.005	1.057
2001	263.02	0.315	0.007	0.045	4.874	0.005	0.971
2002	291.58	0.291	0.007	0.044	4.883	0.005	0.904
2003	315.42	0.277	0.007	0.043	4.949	0.004	0.853
2004	322.42	0.276	0.007	0.042	5.014	0.004	0.806
2005	329.17	0.277	0.007	0.041	5.085	0.004	0.778
2006	318.95	0.294	0.007	0.040	5.079	0.004	0.741
2007	323.70	0.299	0.007	0.039	5.128	0.004	0.712
2008	308.46	0.311	0.007	0.038	5.213	0.003	0.684
2009	301.84	0.312	0.006	0.037	5.218	0.003	0.662
2010	312.68	0.308	0.006	0.037	5.272	0.003	0.683
2011	300.99	0.325	0.006	0.036	5.281	0.003	0.672

Table 171: Implied emission factors for PM and activities for 1 A 3 b Road Transport 1990–2011.

Year	Activity	IEF PM (Exhaust)	IEF TSP Non Exhaust	IEF PM10 Non Exhaust	IEF PM2.5P Non Exhaust
	[PJ]		[t/PJ]		
1990	179.60	16.74	38.12	12.71	3.81
1995	205.67	20.20	39.39	13.13	3.94
2000	244.75	18.91	36.81	12.27	3.68
2001	263.02	18.09	34.75	11.58	3.48
2002	291.58	17.05	32.07	10.69	3.21
2003	315.42	16.40	30.36	10.12	3.04
2004	322.42	15.68	30.38	10.13	3.04
2005	329.17	15.22	30.27	10.09	3.03
2006	318.95	14.05	31.87	10.62	3.19
2007	323.70	12.76	31.93	10.64	3.19
2008	308.46	11.66	33.43	11.14	3.34
2009	301.84	10.71	33.68	11.23	3.37
2010	312.68	9.51	32.91	10.97	3.29
2011	300.99	8.49	34.84	11.61	3.48

3.3.5.4 Recalculations

The inventory data and specific consumption data on passenger cars have been updated with current values derived from CO2 monitoring (BMLFUW 2012) of the new car fleet. This has caused a slight change in specific consumption from last year's inventory.

Because of updates due to changes in the time series of the national energy balance the levels for liquid gas, natural gas and biogas changed retrospectively. The years concerned are especially between 2000 and 2003 and 2009 (HAUSBERGER & SCHWINGSHACKL 2012).

An update of emission factors resulted in a number of single effects:

- Passenger cars: As opposed to the original prognosis, namely that NO_X emissions from EURO 5 diesel engines would be roughly the same as with EURO 4, measurements of the Technical University Graz (HAUSBERGER, S. / REXEIS, M. 2012) conducted in 2012 showed that NO_x emission factors for EURO 5 diesel passenger cars had to be revised upwards. Depending on the traffic situation, the level of emissions with EURO 5 is currently 13 % - 27 % above EURO 4. Although emissions from EURO 6 diesel passenger cars are clearly below EURO 5, they are still above the levels originally predicted.
- Light duty vehicles: No measurement data are available on light duty vehicles. Therefore, the rates of change in relation to EURO 4 were the same as those assumed for passenger cars.
- Heavy duty vehicles: The measurements of EURO 5 heavy duty vehicles which had been available since the last update of emission factors made a 44 % increase of NO_x emission factors necessary. By contrast, measurements of EURO 6 heavy duty vehicles carried out and used in the inventory up to now showed lower emission levels than expected (- 36 % compared to previous emission factors for EURO 6).

These updates overall resulted in a 3.5 % increase in NO_X emissions from road transportation in 2010 compared to the previous submission (calculated on the basis of fuel used).

3.3.5.5 Planned Improvements

At current no relevant improvements are planned.

3.3.6 Other mobile sources – Off Road

3.3.6.1 Methodology

Energy consumption and emissions of off-road traffic in Austria are calculated with the model GEORG (Grazer Emissionsmodell für Off Road Geräte). This model has been developed within a study about off road emissions in Austria (PISCHINGER 2000). The study was prepared to improve the poor data quality in this sector. The following categories were taken into account:

- 1 A 2 f Industry
- 1 A 3 c Railways
- 1 A 3 d Navigation
- 1 A 4 b Household and Gardening
- 1 A 4 c Agriculture and Forestry
- 1 A 5 Military Activities

Depending on the engine's fuel consumption the ratio power of the engine was calculated. Emissions were calculated by multiplying ratio power and emission factors. To improve data quality the influence of the vehicle age on the operating time was taken into account.

With this method all relevant effects on engine emissions could be covered:

- Emissions according to the engine type,
- Emissions according to the effective engine performance,
- Emissions according to the engine age,
- Emissions depending on the engine operating time,
- Engine operating time according to the engine age.

Input data to the model are:

- Machinery stock data (obtained from data on licences. through inquiries and statistical extrapolation);
- Assumptions on drop-out rates of machinery (broken down machinery will be replaced);
- Operating time (obtained through inquiries), related to age of machinery.

From machinery stock data and drop-out rates an age structure of the off road machinery was obtained by GEORG. Emission factors for were defined for four categories of engine type depending on the year of construction. They are listed in Table 172 to Table 175. Depending on the fuel consumption of the engine the ratio power of the engine was calculated.

Emissions were calculated by multiplying an engine specific emission factor (expressed in g/kWh) by the average engine power, the operating time and the number of vehicles

With this bottom-up method national total fuel consumption and total emissions are calculated. Calculated total fuel consumption of off road traffic is then summed up with total fuel consumption of road transport and is compared with national total sold fuel; due to uncertainties of the bottom-up method the values differ by about 5–20%. To be consistent with the national energy balance. activity data in the bottom-up approaches for both road transport and off- road traffic is adjusted so that finally the calculated total fuel consumption equals to the figure of fuel sold in the national energy balance.

The used methodology conforms to the requirements of the IPCC Tier 3 methodology.

3.3.6.2 Emission factors

The following emission factors for four categories of engine types (average motor capacity) depending on the year of construction are used in the GEORG model. They represent emissions according to the engine power output and also fuel consumption.

Table 172: Emission factors for diesel engines > 80 kW.

Year	**NO_x**	**NH_3**	**NMVOC**	**PM**
		[g/kwh]		
1993	10.193	0.003	1.577	1.623
2001	12.392	0.002	1.183	0.885
2003	7.845	0.002	0.307	0.295
2006	5.187	0.001	0.502	0.173
2011	3.292	0.001	0.502	0.173

Table 173: Emission factors for diesel engines < 80 kW.

Year	**NO_x**	**NH_3**	**NMVOC**	**PM**
		[g/kwh]		
1993	11.992	0.006	1.892	2.184
2001	10.923	0.005	1.446	1.682
2003	8.103	0.004	1.179	0.545
2006	6.300	0.003	0.653	0.277
2011	5.250	0.002	0.653	0.277

Table 174: Emission factors for 4-stroke-petrol engines.

Year	**NO_x**	**NH_3**	**NMVOC**	**PM**
		[g/kwh]		
1993	3.070	0.002	15.917	0.025
2001	4.110	0.002	12.738	0.025
2003	4.490	0.002	12.167	0.025
2006	4.490	0.002	11.748	0.025
2011	4.490	0.002	11.117	0.025

Table 175: Emission factors for 2-stroke-petrol engines.

Year	**NO_x**	**NH_3**	**NMVOC**	**PM**
		[g/kwh]		
1993	1.035	0.002	247.797	0.439
2001	1.135	0.002	174.290	0.291
2003	1.675	0.001	164.637	0.291
2006	1.395	0.001	50.490	0.291
2011	1.395	0.000	50.490	0.291

3.3.6.3 Activity data

Activity data, vehicle stock and specific fuel consumption for vehicles and machinery were taken from:

- Statistik Austria (fuel statistic),
- questionnaire to vehicle and machinery users (PISCHINGER 2000),
- Interviews with experts and expert judgment
  validating the questionnaire results (PISCHINGER 2000) and
- information from vehicle and machinery manufacturer.

3.3.6.4 Recalculations

With the introduction of emission level 4 (European emission standards for new non-road (off-road) engines) for off-road equipment for combustion >56 KW, an update of emission factors was carried out. The following emission factors were revised: tractors (agriculture, forestry), construction machinery (large and small machinery), wood chips, combine har-vester, motorised carts, industry (small and large equipment), passenger ships, working boats, ski piste and cross-country track setting equipment.

Because of the integration of new emission levels in the off-road sector a reallocation of mobile machinery and equipment according to size classes and emission levels was necessary. In total, there was – however - no noticeable increase in NO_x emissions (HAUSBERGER, S. / REXEIS, M. 2012).

3.3.6.5 Planned Improvements

At current no relevant improvements are planned.

3.3.7 NFR 1 A 2 f Manufacturing Industries and Construction – Other – mobile sources

Emissions from this category are presented in the following table.

Table 176: Emissions of SO_2, NO_x, NMVOC, NH_3 and CO from 1 A 2 f 2 Off-road – Industry 1990–2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO
			[Mg]		
1990	205	3 029	516	1.1	3 836
1991	232	3 431	581	1.2	4 330
1992	245	3 641	614	1.3	4 579
1993	258	3 833	644	1.4	4 811
1994	230	4 086	666	1.4	4 998
1995	90	4 442	685	1.5	5 188
1996	112	5 748	817	1.8	6 269
1997	105	5 573	746	1.6	5 824
1998	124	6 689	855	1.9	6 724
1999	104	6 469	801	1.8	6 381
2000	121	7 633	922	2.1	7 405
2001	114	7 207	860	1.9	6 968
2002	111	6 969	825	1.8	6 743
2003	118	7 100	815	1.9	6 798
2004	19	7 107	795	2.0	6 727
2005	26	8 492	929	2.5	7 451
2006	32	9 214	1 004	2.8	8 123
2007	7	9 031	991	2.8	8 089
2008	8	9 136	1 023	2.9	8 274
2009	8	8 445	970	2.7	7 886
2010	7	7 899	917	2.6	7 470
2011	7	7 674	904	2.5	7 399
Trend 1990–2011	-96%	153%	75%	131%	93%
Trend 2010–2011	0%	-3%	-1%	-3%	-1%

Table 177: Emissions of heavy metals and POPs from 1 A 2 f 2 Off-road – Industry 1990–2011.

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]
1990	0.069	0.024	100.613	22.83	20.99	0.43
1991	0.078	0.027	93.567	25.81	23.72	0.49
1992	0.083	0.029	77.743	27.33	25.12	0.52
1993	0.087	0.030	59.250	28.74	26.42	0.54
1994	0.091	0.032	38.637	30.16	27.73	0.57
1995	0.097	0.034	0.102	31.99	29.40	0.61

Year	Cd	Hg	Pb	PAH	Diox	HCB
1996	0.121	0.042	0.127	39.85	36.59	0.75
1997	0.114	0.040	0.120	37.58	34.54	0.71
1998	0.134	0.047	0.141	44.19	40.58	0.84
1999	0.128	0.045	0.135	42.27	38.88	0.80
2000	0.150	0.052	0.158	49.43	45.50	0.94
2001	0.141	0.049	0.149	46.51	42.89	0.88
2002	0.137	0.048	0.145	45.31	41.85	0.86
2003	0.146	0.051	0.155	48.33	44.72	0.92
2004	0.160	0.056	0.170	53.08	48.95	1.01
2005	0.219	0.077	0.228	72.75	65.69	1.35
2006	0.263	0.092	0.274	90.42	81.37	1.68
2007	0.283	0.099	0.294	97.81	87.79	1.81
2008	0.310	0.109	0.321	107.70	96.21	1.98
2009	0.298	0.104	0.308	105.40	94.04	1.94
2010	0.287	0.101	0.297	101.07	90.18	1.86
2011	0.285	0.100	0.295	100.58	89.73	1.85
Trend 1990–2011	312%	312%	-99%	341%	328%	328%
Trend 2010–2011	-1%	-1%	-1%	0%	0%	0%

Table 178: Emissions of TSP, PM10 and PM2.5 from 1 A 2 f 2 Off-road – Industry 1990–2011.

Year	TSP	PM10	PM2.5
		[Mg]	
1990	872	681	566
1995	1 159	888	726
2000	1 589	1 150	887
2001	1 481	1 068	820
2002	1 426	1 024	783
2003	1 456	1 027	769
2004	1 492	1 019	735
2005	1 885	1 227	833
2006	2 153	1 332	839
2007	2 207	1 318	785
2008	2 350	1 370	781
2009	2 249	1 288	712
2010	2 131	1 210	658
2011	2 110	1 189	636
Trend 1990–2011	*142%*	*75%*	*12%*
Trend 2010–2011	*-1%*	*-2%*	*-3%*

Activities used for estimating the emissions and implied emission factors are presented in the following tables:

Table 179: Activities for 1 A 2 f 2 Off-road – Industry) 1990–2011.

Year	Liquid fuels [PJ]
1990	3.46
1991	3.91
1992	4.14
1993	4.35
1994	4.57
1995	4.84
1996	6.04
1997	5.69
1998	6.69
1999	6.40
2000	7.48
2001	7.03
2002	6.84
2003	7.29
2004	8.02
2005	11.11
2006	13.83
2007	14.98
2008	16.53
2009	16.19
2010	15.52
2011	15.45
Trend 1990–2011	*347%*
Trend 2010–2011	*0%*

Table 180: Implied Emission factors for 1 A 2 f 2 Off-road – Industry 1990–2011.

Year	IEF SO_2	IEF NO_x	IEF NMVOC	IEF NH_3	IEF CO
			[t/PJ]		
1990	59.32	876.46	149.36	0.31	1110.02
1991	59.31	878.34	148.85	0.31	1108.29
1992	59.32	880.05	148.41	0.32	1106.92
1993	59.31	881.21	148.13	0.32	1105.92
1994	50.29	895.13	145.78	0.31	1094.90
1995	18.54	917.02	141.42	0.31	1070.95
1996	18.54	952.19	135.36	0.30	1038.56
1997	18.54	979.41	131.19	0.29	1023.63
1998	18.54	999.68	127.81	0.28	1004.91

Year	IEF SO_2	IEF NO_x	IEF NMVOC	IEF NH_3	IEF CO
			[t/PJ]		
1999	16.19	1011.31	125.21	0.28	997.48
2000	16.19	1020.71	123.31	0.27	990.24
2001	16.18	1025.36	122.31	0.27	991.37
2002	16.18	1018.70	120.61	0.27	985.68
2003	16.17	973.75	111.76	0.26	932.25
2004	2.34	886.06	99.08	0.25	838.66
2005	2.34	764.45	83.66	0.22	670.71
2006	2.35	666.32	72.60	0.20	587.41
2007	0.47	602.94	66.14	0.19	540.07
2008	0.47	552.73	61.90	0.18	500.62
2009	0.47	521.72	59.95	0.17	487.18
2010	0.47	508.87	59.07	0.17	481.23
2011	0.47	496.79	58.50	0.16	479.04

Recalculations

See recalculations above for Other mobile sources – Off-road.

3.3.8 NFR 1 A 3 c Railways

Only diesel oil and coal engines are taken into account. Emissions driven by power plants due to production of electricity for electric engines are not included to avoid double counting of emissions.

Table 181: Emissions of SO_2, NO_x, NMVOC, NH_3 and CO from Category 1 A 3 c Railways 1990–2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO
			[Mg]		
1990	264	1 819	365	0.71	2 036
1991	241	1 673	334	0.65	1 863
1992	245	1 665	331	0.65	1 848
1993	230	1 629	321	0.63	1 795
1994	230	1 658	322	0.63	1 804
1995	207	1 560	299	0.59	1 682
1996	149	1 421	270	0.55	1 519
1997	103	1 432	264	0.50	1 488
1998	96	1 423	258	0.48	1 459
1999	95	1 484	264	0.49	1 499
2000	88	1 497	261	0.48	1 486
2001	73	1 458	248	0.45	1 418
2002	80	1 592	261	0.48	1 503
2003	72	1 595	256	0.48	1 480

Year	SO_2	NO_x	NMVOC	NH_3	CO
			[Mg]		
2004	55	1 587	248	0.45	1 441
2005	61	1 830	283	0.52	1 648
2006	62	1 829	281	0.52	1 634
2007	62	1 794	274	0.51	1 597
2008	60	1 767	268	0.50	1 567
2009	62	1 714	259	0.48	1 515
2010	59	1 688	253	0.47	1 484
2011	59	1 662	247	0.46	1 455
Trend 1990–2011	-78%	-9%	-32%	-35%	-29%
Trend 2010–2011	0%	-2%	-2%	-2%	-2%

Table 182: Emissions of heavy metals and POPs from Category 1 A 3 c Railways 1990–2011.

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]
1990	0.423	0.762	6.251	20.743	39.227	0.808
1991	0.385	0.693	5.684	18.980	35.770	0.737
1992	0.400	0.723	5.933	19.087	36.721	0.756
1993	0.364	0.654	5.364	18.235	34.029	0.701
1994	0.359	0.644	5.277	18.278	33.765	0.696
1995	0.368	0.666	5.466	17.563	33.813	0.697
1996	0.363	0.663	5.445	16.323	32.687	0.673
1997	0.222	0.382	3.110	14.207	22.815	0.470
1998	0.201	0.342	2.776	13.740	21.262	0.438
1999	0.195	0.328	2.660	14.029	21.108	0.435
2000	0.176	0.290	2.347	13.730	19.771	0.407
2001	0.133	0.206	1.651	12.677	16.468	0.339
2002	0.145	0.226	1.807	13.733	17.906	0.369
2003	0.122	0.180	1.422	13.433	16.317	0.336
2004	0.071	0.079	0.588	12.637	12.758	0.263
2005	0.071	0.071	0.505	14.531	14.080	0.290
2006	0.074	0.077	0.562	14.641	14.374	0.296
2007	0.071	0.074	0.535	14.531	14.189	0.292
2008	0.067	0.066	0.473	14.461	13.917	0.287
2009	0.074	0.081	0.599	14.315	14.232	0.293
2010	0.064	0.061	0.434	14.142	13.511	0.278
2011	0.064	0.062	0.443	14.052	13.467	0.277
Trend 1990–2011	*-85%*	*-92%*	*-93%*	*-32%*	*-66%*	*-66%*
Trend 2010–2011	*0%*	*2%*	*2%*	*-1%*	*0%*	*0%*

Table 183: Emissions of TSP, PM10 and PM2.5 from Category 1 A 3 c Railways 1990–2011.

Year	TSP	PM10	PM2.5
		[Mg]	
1990	1 975	938	575
1995	1 867	830	467
2000	1 765	728	365
2001	1 745	708	345
2002	1 750	713	350
2003	1 734	697	334
2004	1 711	674	311
2005	1 716	679	316
2006	1 699	662	299
2007	1 683	646	283
2008	1 670	633	270
2009	1 660	623	260
2010	1 654	617	254
2011	1 646	609	246
Trend 1990–2011	*-17%*	*-35%*	*-57%*
Trend 2010–2011	*0%*	*-1%*	*-3%*

Activities used for estimating the emissions and implied emission factors are presented in the following tables:

Table 184: Activities for 1 A 3 c Railways 1990–2011.

Year	Liquid fuels [PJ]	Solid fuels [PJ]
1990	2 315	70
1991	2 124	63
1992	2 103	66
1993	2 055	60
1994	2 075	59
1995	1 934	61
1996	1 743	61
1997	1 761	35
1998	1 738	31
1999	1 800	29
2000	1 800	26
2001	1 740	18
2002	1 882	20
2003	1 892	16
2004	1 892	6
2005	2 202	5
2006	2 210	6

Year	Liquid fuels [PJ]	Solid fuels [PJ]
2007	2 197	6
2008	2 195	5
2009	2 153	6
2010	2 151	4
2011	2 135	5
Trend 1990–2011	*-8%*	*-93%*
Trend 2010–2011	*-1%*	*2%*

Table 185: Implied emission factors (IEF) for 1 A 3 c Railways 1990–2011.

Year	IEF SO_2	IEF NO_x	IEF NMVOC	IEF NH_3	IEF CO	IEF Cd	IEF Hg	IEF Pb
	[t/PJ]					Mg / PJ		
1990	110.54	762.62	153.12	0.30	853.55	0.177	0.320	2.621
1991	110.11	765.11	152.67	0.30	852.02	0.176	0.317	2.599
1992	112.74	767.31	152.45	0.30	851.72	0.184	0.333	2.735
1993	108.90	770.41	151.71	0.30	848.68	0.172	0.309	2.536
1994	107.68	777.18	150.79	0.29	845.39	0.168	0.302	2.473
1995	103.84	781.58	150.00	0.30	842.77	0.184	0.334	2.740
1996	82.80	787.59	149.58	0.30	842.19	0.201	0.367	3.018
1997	57.33	797.38	146.79	0.28	829.03	0.124	0.213	1.732
1998	54.11	804.84	145.65	0.27	824.71	0.114	0.193	1.570
1999	52.11	811.15	144.21	0.27	818.88	0.107	0.179	1.454
2000	48.44	819.66	142.85	0.26	813.70	0.096	0.159	1.285
2001	41.58	829.72	141.14	0.26	806.93	0.076	0.117	0.939
2002	42.13	837.25	137.31	0.25	790.56	0.076	0.119	0.951
2003	37.99	836.20	134.25	0.25	775.88	0.064	0.094	0.745
2004	29.02	835.75	130.79	0.24	759.15	0.038	0.042	0.310
2005	27.50	829.23	128.42	0.23	746.65	0.032	0.032	0.229
2006	28.12	825.40	126.64	0.23	737.55	0.033	0.035	0.253
2007	27.94	814.65	124.31	0.23	725.27	0.032	0.034	0.243
2008	27.32	803.35	121.82	0.23	712.15	0.031	0.030	0.215
2009	28.66	793.55	119.77	0.22	701.48	0.034	0.038	0.278
2010	27.30	783.00	117.32	0.22	688.58	0.030	0.028	0.201
2011	27.52	776.64	115.60	0.22	679.98	0.030	0.029	0.207

Emission factors for heavy metals, POPs and PM are presented in the following chapter.

Recalculations

An update of the particulate emissions of railways in the model GEORG for the period 1990 - 2011 brings a reduction in particulate emissions (minus 20% for the year 2010) in comparison to last year's submission. The emission factors of new locomotives were adapted to the current limit values (Directive 97/68/EC) for "railcars and locomotives."

3.3.9 NFR 1 A 3 d Navigation

This sector inlcudes emissions from fuels used by vessels of all flags that depart and arrive in Austria (excludes fishing) and emissions from international inland waterways, including emissions from journeys that depart in Austria and arrive in a different country.

Table 186: Emissions of SO_2, NO_x, NMVOC, NH3 and CO from Category 1 A 3 d Navigation 1990–2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP=PM10= PM2.5
			[Mg]			
1990	36	463	516	0.15	3 057	114
1991	32	414	514	0.13	2 982	NE
1992	31	405	513	0.13	2 951	NE
1993	31	411	512	0.13	2 937	NE
1994	38	509	506	0.16	3 004	NE
1995	36	572	496	0.18	3 019	129
1996	17	591	486	0.18	2 988	NE
1997	17	591	476	0.18	2 938	NE
1998	19	647	466	0.19	2 945	NE
1999	18	640	456	0.19	2 888	NE
2000	20	703	447	0.20	2 901	133
2001	21	741	438	0.21	2 890	134
2002	23	827	428	0.23	2 907	142
2003	19	667	419	0.19	2 703	112
2004	22	811	403	0.22	2 781	139
2005	21	789	382	0.22	2 715	132
2006	19	689	362	0.19	2 582	112
2007	20	726	342	0.20	2 578	115
2008	18	652	323	0.18	2 478	99
2009	15	551	305	0.15	2 356	81
2010	18	636	287	0.17	2 401	93
2011	16	563	269	0.15	2 309	101
Trend 1990–2011	*-55%*	*22%*	*-48%*	*5%*	*-24%*	*-11%*
Trend 2010–2011	*-11%*	*-11%*	*-6%*	*-12%*	*-4%*	*10%*

Table 187: Emissions of heavy metals and POPs from Category 1 A 3 d Navigation 1990–2011.

Year	Cd	Hg	Pb	PAH	Dioxin/Furan	HCB
	[kg]	[kg]	[kg]	[kg]	[mg]	[g]
1990	0.014	0.005	279.360	4.42	9.41	0.19
1991	0.013	0.005	229.152	4.00	9.04	0.19
1992	0.013	0.004	179.223	3.91	8.95	0.18
1993	0.013	0.004	129.547	3.94	8.97	0.18
1994	0.015	0.005	79.942	4.71	9.61	0.20
1995	0.017	0.006	0.027	5.19	9.99	0.21
1996	0.017	0.006	0.028	5.30	10.05	0.21
1997	0.017	0.006	0.027	5.26	9.98	0.21
1998	0.018	0.006	0.029	5.65	10.29	0.21
1999	0.018	0.006	0.028	5.55	10.18	0.21
2000	0.019	0.007	0.030	5.99	10.52	0.22
2001	0.020	0.007	0.030	6.22	10.70	0.22
2002	0.022	0.008	0.032	6.81	11.16	0.23
2003	0.018	0.006	0.028	5.60	10.07	0.21
2004	0.021	0.007	0.031	6.70	10.96	0.23
2005	0.021	0.007	0.031	6.49	10.72	0.22
2006	0.018	0.006	0.028	5.56	9.93	0.20
2007	0.019	0.007	0.028	5.86	10.11	0.21
2008	0.017	0.006	0.027	5.33	9.58	0.20
2009	0.014	0.005	0.024	4.52	8.69	0.18
2010	0.017	0.006	0.026	5.24	9.27	0.19
2011	0.015	0.005	0.024	4.71	8.75	0.18
Trend 1990–2011	4%	4%	-99%	7%	-7%	-7%
Trend 2010–2011	-10%	-10%	-7%	-10%	-6%	-6%

Activities used for estimating the emissions and the implied emission factors are presented in the following table:

Table 188: Activities for 1 A 3 d Navigation 1990–2011.

Year	Liquid fuels [TJ]
1990	713
1991	648
1992	634
1993	639
1994	759
1995	834
1996	850
1997	844

Year	Liquid fuels [TJ]
1998	906
1999	890
2000	958
2001	994
2002	1 086
2003	896
2004	1 069
2005	1 036
2006	890
2007	936
2008	854
2009	726
2010	838
2011	755
Trend 1990–2011	*6%*
Trend 2010–2011	*-10%*

Table 189: Implied emission factors (IEF) for 1 A 3 d Navigation 1990–2011.

Year	IEF SO_2	IEF NO_x	IEF NMVOC	IEF NH_3	IEF CO	IEF PM
			[t/PJ]			
1990	50.36	648.94	723.17	0.21	4285.35	159.54
1991	49.38	639.53	793.81	0.20	4601.75	-
1992	49.18	639.30	808.72	0.20	4653.06	-
1993	49.29	642.90	801.01	0.20	4598.22	-
1994	50.68	670.34	666.44	0.21	3958.03	-
1995	42.83	685.85	594.70	0.21	3620.23	154.34
1996	20.56	694.70	571.61	0.21	3513.61	-
1997	20.53	700.81	564.27	0.21	3482.02	-
1998	20.74	714.85	514.81	0.21	3251.64	-
1999	20.59	719.28	513.12	0.21	3246.02	-
2000	20.81	734.17	466.52	0.21	3028.52	138.45
2001	20.90	746.17	440.48	0.21	2908.76	135.13
2002	21.13	761.01	394.23	0.21	2676.10	130.53
2003	20.68	744.10	467.19	0.21	3015.51	124.50
2004	20.49	758.88	377.05	0.21	2602.16	129.82
2005	20.75	761.90	368.82	0.21	2621.30	127.61
2006	21.16	774.03	406.47	0.21	2901.20	125.90
2007	21.26	775.04	365.47	0.21	2752.99	122.72

Year	IEF SO_2	IEF NO_x	IEF NMVOC	IEF NH_3	IEF CO	IEF PM
			[t/PJ]			
2008	21.16	764.14	378.55	0.21	2902.90	115.45
2009	21.11	758.75	419.66	0.21	3246.16	111.79
2010	21.63	759.15	342.10	0.21	2865.31	110.51
2011	21.44	745.97	356.86	0.20	3058.26	134.33

3.3.10 NFR 1 A 4 b Household and gardening – mobile sources

In addition to vehicles used in household and gardening this category contains ski slope machineries and snow vehicles.

Emissions from this category decreased over the period from 1990 to 2011.

Table 190: Emissions of SO_2, NO_x, NMVOC, NH_3, CO and PM from 1 A 4 b ii Off-road –Household and gardening 1990–2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP=PM10 = PM2.5
			[Mg]			
1990	57	803	4 790	0.28	21 712	134.59
1991	57	808	4 805	0.28	21 764	NE
1992	57	822	4 830	0.29	21 875	NE
1993	58	833	4 842	0.29	21 930	NE
1994	49	840	4 756	0.29	21 672	NE
1995	22	876	4 591	0.29	21 176	123.51
1996	21	886	4 422	0.28	20 657	NE
1997	21	895	4 251	0.28	20 134	NE
1998	21	905	4 079	0.27	19 606	NE
1999	19	919	3 938	0.27	19 232	NE
2000	19	938	3 816	0.27	18 913	96.87
2001	19	956	3 725	0.26	18 691	92.83
2002	19	960	3 652	0.26	18 403	87.08
2003	19	951	3 615	0.25	18 121	80.23
2004	4	932	3 446	0.25	17 901	73.44
2005	4	904	3 145	0.24	17 632	66.69
2006	4	874	2 852	0.23	17 413	60.39
2007	1	837	2 550	0.23	17 186	54.52
2008	1	794	2 249	0.22	16 989	49.10

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP=PM10 = PM2.5
			[Mg]			
2009	1	750	1 966	0.20	16 852	44.02
2010	1	702	1 722	0.19	16 772	39.20
2011	1	656	1 532	0.18	16 802	35.14
Trend 1990–2011	*-99%*	*-18%*	*-68%*	*-36%*	*-23%*	*-74%*
Trend 2010–2011	*0%*	*-7%*	*-11%*	*-5%*	*0%*	*-10%*

Table 191: Emissions of heavy metals and POPs from 1 A 4 b ii Off-road – Household and gardening 1990–2011.

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]
1990	0.039	0.014	2 250.43	28.41	54.95	1.13
1991	0.039	0.014	1 856.89	28.49	55.13	1.14
1992	0.039	0.014	1 463.23	28.69	55.45	1.14
1993	0.040	0.014	1 062.64	28.79	55.62	1.15
1994	0.039	0.014	657.02	28.69	55.47	1.14
1995	0.040	0.014	0.13	28.65	55.25	1.14
1996	0.039	0.014	0.13	28.42	54.86	1.13
1997	0.039	0.014	0.13	28.20	54.49	1.12
1998	0.038	0.013	0.12	27.99	54.11	1.11
1999	0.038	0.013	0.12	28.00	54.15	1.12
2000	0.038	0.013	0.12	28.02	54.21	1.12
2001	0.038	0.013	0.12	28.09	54.38	1.12
2002	0.038	0.013	0.12	28.04	54.27	1.12
2003	0.038	0.013	0.12	27.93	54.06	1.11
2004	0.038	0.013	0.12	27.69	53.52	1.10
2005	0.037	0.013	0.12	27.22	52.50	1.08
2006	0.037	0.013	0.12	27.14	52.34	1.08
2007	0.036	0.013	0.12	26.64	51.21	1.05
2008	0.035	0.012	0.11	26.17	50.09	1.03
2009	0.034	0.012	0.11	25.25	48.03	0.99
2010	0.033	0.012	0.11	24.95	47.44	0.98
2011	0.033	0.012	0.11	24.70	46.92	0.97
Trend 1990–2011	*-16%*	*-16%*	*-99%*	*-13%*	*-15%*	*-15%*
Trend 2010–2011	*-1%*	*-1%*	*-1%*	*-1%*	*-1%*	*-1%*

Activities used for estimating emissions and the implied emission factors are presented in the following table.

Table 192: Activities for 1 A 4 b ii Off-road – Household and gardening 1990–2011.

Year	**Liquid fuels [PJ]**
1990	1.947
1991	1.951
1992	1.969
1993	1.979
1994	1.968
1995	1.977
1996	1.956
1997	1.938
1998	1.921
1999	1.919
2000	1.919
2001	1.922
2002	1.918
2003	1.912
2004	1.900
2005	1.878
2006	1.872
2007	1.852
2008	1.837
2009	1.795
2010	1.778
2011	1.762
Trend 1990–2011	*-10%*
Trend 2010–2011	*-1%*

Table 193: Implied Emission factors for 1 A 4 b ii Off-road – Household and gardening 1990–2011.

Year	**IEF SO_2**	**IEF NO_x**	**IEF NMVOC**	**IEF NH_3**	**IEF CO**
			[t/PJ]		
1990	29.07	412	2 460	0.14	11 148
1991	29.02	414	2 462	0.14	11 153
1992	29.13	418	2 453	0.15	11 111
1993	29.22	421	2 447	0.15	11 081
1994	25.08	427	2 416	0.15	11 012
1995	10.96	443	2 322	0.15	10 713
1996	10.93	453	2 261	0.14	10 562
1997	10.90	462	2 194	0.14	10 391
1998	10.89	471	2 123	0.14	10 205
1999	9.82	479	2 053	0.14	10 023
2000	9.81	489	1 988	0.14	9 854
2001	9.80	497	1 938	0.14	9 725

Year	IEF SO_2	IEF NO_x	IEF NMVOC	IEF NH_3	IEF CO
			[t/PJ]		
2002	9.80	500	1 904	0.14	9 593
2003	9.81	498	1 891	0.13	9 477
2004	2.35	491	1 813	0.13	9 420
2005	2.35	481	1 675	0.13	9 391
2006	2.33	467	1 523	0.12	9 301
2007	0.46	452	1 377	0.12	9 282
2008	0.46	432	1 224	0.12	9 247
2009	0.47	418	1 095	0.11	9 387
2010	0.47	395	968	0.11	9 435
2011	0.47	372	870	0.10	9 534

3.3.11 NFR 1 A 4 c Agriculture and forestry – mobile sources

Emissions from this category decreased over the period from 1990 to 2011.

Table 194: Emissions of SO_2, NO_x, NMVOC, NH_3, and CO from 1 A 4 c ii Off-road Vehicles and Other Machinery – Agriculture/Forestry/Fishing: 1990–2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO
			[Mg]		
1990	601	9 419	4 252	4.7	20 107
1991	602	9 460	3 663	4.7	18 495
1992	607	9 569	3 772	4.7	18 779
1993	610	9 651	3 770	4.8	18 759
1994	520	9 735	4 033	4.8	19 391
1995	185	9 328	3 824	4.5	18 468
1996	192	9 717	3 985	4.6	18 910
1997	202	10 243	3 962	4.7	18 944
1998	198	10 075	3 771	4.6	18 228
1999	176	10 188	3 716	4.6	18 011
2000	170	9 889	3 500	4.4	17 205
2001	176	10 207	3 500	4.5	17 251
2002	175	10 043	3 572	4.4	17 132
2003	167	9 438	3 679	4.1	16 810
2004	25	9 489	3 557	4.1	16 372
2005	27	9 807	3 539	4.3	16 390
2006	27	9 558	3 738	4.2	16 645
2007	6	9 288	3 880	4.1	16 785

Year	SO_2	NO_x	NMVOC	NH_3	CO
			[Mg]		
2008	6	9 029	3 848	4.0	16 555
2009	5	7 976	3 140	3.5	14 424
2010	5	7 443	3 153	3.3	14 196
2011	5	7 737	3 259	3.4	14 571
Trend 1990–2011	*-99%*	*-18%*	*-23%*	*-26%*	*-28%*
Trend 2010–2011	*9%*	*4%*	*3%*	*4%*	*3%*

Table 195: Emissions of heavy metals and POPs from 1 A 4 c ii Off-road Vehicles and Other Machinery – Agriculture/Forestry/Fishing: 1990–2011.

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[kg]	[kg]	[kg]	[kg]	[kg]	[kg]
1990	0.208	0.073	922.200	69.60	75.41	1.55
1991	0.207	0.073	660.122	68.48	72.84	1.50
1992	0.209	0.073	532.057	69.22	73.78	1.52
1993	0.210	0.074	385.985	69.54	74.09	1.53
1994	0.212	0.074	256.794	70.54	75.78	1.56
1995	0.204	0.071	0.237	67.65	73.07	1.51
1996	0.212	0.074	0.247	70.49	75.97	1.57
1997	0.222	0.078	0.257	73.81	78.73	1.62
1998	0.218	0.076	0.252	72.35	77.22	1.59
1999	0.221	0.077	0.255	73.16	77.93	1.61
2000	0.214	0.075	0.247	70.85	75.61	1.56
2001	0.221	0.077	0.254	72.96	77.46	1.60
2002	0.220	0.077	0.254	72.89	77.81	1.60
2003	0.211	0.074	0.247	70.53	76.48	1.58
2004	0.217	0.076	0.253	72.34	77.72	1.60
2005	0.228	0.080	0.263	76.78	81.43	1.68
2006	0.222	0.078	0.260	77.77	83.40	1.72
2007	0.223	0.078	0.263	78.92	85.05	1.75
2008	0.224	0.078	0.264	80.06	86.08	1.77
2009	0.202	0.071	0.236	72.85	77.61	1.60
2010	0.198	0.069	0.234	71.51	76.83	1.58
2011	0.213	0.075	0.250	77.11	81.86	1.69
Trend 1990–2011	*2%*	*2%*	*-99%*	*11%*	*9%*	*9%*
Trend 2010–2011	*8%*	*8%*	*7%*	*8%*	*7%*	*7%*

Table 196: Emissions of TSP, PM10 and PM2.5 from 1 A 4 c ii Off-road Vehicles and Other Machinery – Agriculture/ Forestry/Fishing: 1990–2011.

Year	**TSP**	**PM10**	**PM2.5**
		[Mg]	
1990	254 216	231 020	217 102
1995	235 406	212 178	198 240
2000	226 880	201 811	186 769
2001	230 960	205 053	189 509
2002	224 063	198 226	182 723
2003	207 614	182 761	167 850
2004	204 984	179 369	164 001
2005	208 639	181 368	165 006
2006	201 955	174 451	157 949
2007	197 386	168 457	151 100
2008	190 259	160 999	143 443
2009	162 777	137 601	122 496
2010	153 187	127 707	112 419
2011	156 962	129 775	113 463
Trend 1990–2011	*-38%*	*-44%*	*-48%*
Trend 2010–2011	*2%*	*2%*	*1%*

Activities used for estimating emissions and the implied emission factors are presented in the following table.

Table 197: Activities from 1 A 4 c ii Off-road Vehicles and Other Machinery – Agriculture/Forestry/Fishing: 1990–2011.

Year	**Liquid fuels [PJ]**
1990	0.916
1991	0.903
1992	0.915
1993	0.920
1994	0.935
1995	0.896
1996	0.932
1997	0.976
1998	0.957
1999	0.968
2000	0.937
2001	0.965
2002	0.964
2003	0.931
2004	0.957
2005	1.003

Year	Liquid fuels [PJ]
2006	0.976
2007	1.078
2008	1.088
2009	0.815
2010	0.872
2011	0.905
Trend 1990–2011	-1%
Trend 2010–2011	4%

Table 198: Implied Emission factors for 1 A 4 c ii Off-road Vehicles and Other Machinery – Agriculture/Forestry/Fishing: 1990–2011.

Year	IEF SO_2	IEF NO_x	IEF NMVOC	IEF NH_3	IEF CO
			[t/PJ]		
1990	656	10 278	4 640	5.07	21 941
1991	657	10 323	3 997	5.12	20 182
1992	662	10 442	4 116	5.15	20 492
1993	665	10 531	4 114	5.21	20 469
1994	568	10 623	4 401	5.21	21 160
1995	202	10 179	4 173	4.90	20 153
1996	210	10 603	4 348	5.00	20 635
1997	220	11 177	4 324	5.17	20 672
1998	217	10 994	4 115	5.01	19 890
1999	192	11 117	4 055	4.99	19 654
2000	186	10 791	3 819	4.78	18 774
2001	192	11 138	3 819	4.87	18 824
2002	191	10 959	3 898	4.76	18 695
2003	183	10 298	4 015	4.48	18 343
2004	28	10 354	3 882	4.52	17 865
2005	29	10 702	3 862	4.67	17 885
2006	30	10 430	4 078	4.59	18 164
2007	6	10 136	4 234	4.46	18 315
2008	6	9 853	4 199	4.33	18 065
2009	6	8 704	3 427	3.85	15 740
2010	6	8 122	3 441	3.60	15 490
2011	6	8 442	3 556	3.74	15 900

3.3.12 NFR 1 A 5 Other

In this category military off-road transport and military aviation are considered.

3.3.12.1 Military off-road transport

Estimates for military activities were taken from (PISCHINGER 2000). Information on the fleet composition was taken from official data presented in the internet as no other data was available. Also, no information on the road performance of military vehicles was available. That's why emission estimates only present rough estimations which were obtained making the following assumptions: for passenger cars and motorcycles the yearly road performance as calculated for civil cars was used. For tanks and other special military vehicles the emission factors for diesel engines > 80 kW was used (for these vehicles a power of 300 kW was assumed). The yearly road performance for such vehicles was estimated to be 30 h/year (as a lot of vehicles are old and many are assumed not to be in actual use anymore).

The emission from NFR 1 A 5 a Other - Military off-road transport are included in NFR 1 A 5 b Other – Military aviation.

3.3.12.2 Military aviation

For the years 1990–1999 emission estimates were taken from an aviation study commissioned by the Umweltbundesamt (KALIVODA et al. 2002).

For the years 1999–2010 emissions for military flights have been calculated with IEF from the year 2000 by the study mentioned above (KALIVODA et al. 2002).

Calculation of emissions from military aviation did not distinguish between LTO and cruise.

The emission from NFR 1 A 5 a Other - Military off-road transport are included in NFR 1 A 5 b Other – Military aviation.

Table 199: Emissions of SO_2, NO_x, NMVOC, NH_3 and CO from 1 A 5 b Military Aviation and Off-road Transport 1990–2011.

Year	SO_2	NO_x	NMVOC	NH_3	CO	TSP	PM10	PM2.5
				[Mg]				
1990	12.2	74.6	14.1	0.08	220.5	17.00	16.25	15.80
1991	12.9	77.9	14.7	0.09	232.9	NE	NE	NE
1992	11.8	72.7	13.7	0.08	212.3	NE	NE	NE
1993	13.6	81.6	15.4	0.09	246.7	NE	NE	NE
1994	14.0	85.4	16.0	0.10	259.4	NE	NE	NE
1995	10.3	72.3	13.1	0.08	204.9	15.47	14.73	14.29
1996	12.3	82.7	14.9	0.09	242.6	NE	NE	NE
1997	11.7	80.6	14.2	0.09	231.2	NE	NE	NE
1998	13.4	89.4	15.8	0.10	262.7	NE	NE	NE
1999	13.1	88.8	15.4	0.10	257.4	NE	NE	NE
2000	12.8	88.0	15.1	0.09	252.6	17.27	16.55	16.12
2001	13.0	89.1	15.2	0.10	255.8	17.36	16.64	16.21
2002	13.2	89.5	15.2	0.10	258.3	17.40	16.69	16.26
2003	13.3	89.3	15.1	0.10	260.3	17.39	16.68	16.25
2004	13.1	88.6	15.1	0.10	262.3	17.36	16.65	16.22
2005	13.3	87.4	15.0	0.10	264.3	17.33	16.61	16.19
2006	13.5	86.3	15.0	0.09	266.3	17.28	16.57	16.14
2007	13.6	84.9	15.0	0.09	268.4	17.25	16.53	16.10
2008	13.8	83.7	15.0	0.09	271.0	17.27	16.56	16.13
2009	14.0	82.8	15.1	0.09	273.8	17.34	16.62	16.19
2010	14.2	82.3	15.2	0.10	276.7	17.45	16.74	16.30
2011	14.4	82.1	15.4	0.10	279.8	17.57	16.86	16.43
Trend 1990–2011	*18%*	*10%*	*9%*	*19%*	*27%*	*3%*	*4%*	*4%*
Trend 2010–2011	*1%*	*0%*	*1%*	*1%*	*1%*	*1%*	*1%*	*1%*

Table 200: Emissions of heavy metals and POPs from 1 A 5 b Military Aviation and Off-road transport 1990–2011.

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[kg]	[kg]	[kg]	[kg]	[mg]	[g]
1990	0.010	0.003	0.010	0.183	0.158	0.003
1991	0.010	0.004	0.010	0.183	0.157	0.003
1992	0.009	0.003	0.009	0.183	0.157	0.003
1993	0.011	0.004	0.011	0.183	0.157	0.003
1994	0.011	0.004	0.011	0.182	0.156	0.003
1995	0.009	0.003	0.009	0.181	0.155	0.003
1996	0.011	0.004	0.011	0.180	0.154	0.003
1997	0.010	0.004	0.010	0.178	0.153	0.003

Year	Cd	Hg	Pb	PAH	Diox	HCB
	[kg]	[kg]	[kg]	[kg]	[mg]	[g]
1998	0.012	0.004	0.012	0.177	0.152	0.003
1999	0.011	0.004	0.011	0.177	0.152	0.003
2000	0.011	0.004	0.011	0.176	0.151	0.003
2001	0.011	0.004	0.011	0.175	0.151	0.003
2002	0.012	0.004	0.012	0.175	0.150	0.003
2003	0.012	0.004	0.012	0.174	0.150	0.003
2004	0.012	0.004	0.012	0.174	0.150	0.003
2005	0.012	0.004	0.012	0.174	0.150	0.003
2006	0.012	0.004	0.012	0.174	0.149	0.003
2007	0.012	0.004	0.012	0.174	0.149	0.003
2008	0.012	0.004	0.012	0.174	0.150	0.003
2009	0.013	0.004	0.013	0.174	0.150	0.003
2010	0.013	0.004	0.013	0.175	0.150	0.003
2011	0.013	0.005	0.013	0.174	0.149	0.003
Trend 1990–2011	33%	33%	33%	-5%	-5%	-5%
Trend 2010–2011	1%	1%	1%	-1%	-1%	-1%

Activities used for estimating the emissions are presented in the following table:

Table 201: Activities from 1 A 5 b Military Aviation and Off-road Transport 1990–2011.

Year	Liquid fuels [TJ]
1990	484
1991	513
1992	465
1993	545
1994	575
1995	447
1996	535
1997	510
1998	584
1999	571
2000	561
2001	568
2002	576
2003	583
2004	591
2005	599
2006	606
2007	614

Year	Liquid fuels [TJ]
2008	622
2009	630
2010	638
2011	646
Trend 1990–2011	*34%*
Trend 2010–2011	*1%*

3.3.13 Emission factors for heavy metals, POPs and PM used in NFR 1 A 3

In the following chapter the emission factors for heavy metals. POPs and PM which are used in NFR 1 A 3 are described.

3.3.13.1 Emission factors for heavy metals used in NFR 1 A 3

As can be seen in Table 61, the HM content of lighter oil products in Austria are below the detection limit. For Cd and Hg and for Pb from 1995 onwards 50% of the detection limit was used as emission factor for all years.

For Pb emission factors for gasoline before 1995 were calculated from the legal content limit for the different types of gasoline and the amounts sold of the different types in the respective year. Furthermore it was considered that according to the CORINAIR 1997 Guidebook the emission rate for conventional engines is 75% and for engines with catalyst 40% (the type of fuel used in the different engine types was also considered).

The production and import of leaded gasoline has been prohibited since 1993. In Austria and that earlier emission estimates are based on a lead content of 0.56 g Pb/litre for aviation gasoline. From 1996 on a lead content of 0,1 mg/GJ has been estimated for gasoline due to the assumed use of lead additives for old non-catalyst vehicles and that a lead content of 0.02 mg/GJ has been assumed for diesel oil.

The same emission factors were also used for mobile combustion in Categories NFR *1 A 2* and NFR *1 A 4*.

For coal fired steam locomotives the emission factor for uncontrolled coal combustion from the CORINAIR 1997 Guidebook were used.

The emission factors for 'automobile tyre and break wear' were taken from (VAN DER MOST & VELDT 1992), where it was considered that only 10% of the emitted particulate matter (PM) were relevant as air pollutants.

Table 202: HM emission factors for Sector 1 A 3 Transport and SNAP 08 Off-Road Machinery.

EF [mg/GJ]	Cd	Hg	Pb
Diesel. kerosine gasoline. aviation gasoline *(see also following Table)*	0.02	0.01	0.02
Coal (railways)	5.4	10.7	89
Automobile tyre and breakwear: passenger cars. motorcyles	0.5	–	–
Automobile tyre and breakwear: LDV and HDV	5.0	–	–

Table 203: Pb emission factors for gasoline for Sector 1 A 3 Transport and SNAP 08 Off-Road Machinery.

Pb EF [mg/GJ]	1985	1990	1995
gasoline (conventional)	2 200	2 060	0.1
gasoline (catalyst)	130	130	0.1
gasoline type jet fuel	23 990	15 915	0.1

3.3.13.2 Emission factors for POPs used in NFR 1 A 3

In the following the emission factors for POPs used in NFR 1 A 3 are described.[113]

Dioxin emission factors base on findings from (HAGENMAIER et al. 1995).

For estimating PAK emissions trimmed averages from emission factors in (UBA BERLIN 1998). (SCHEIDL 1996). (ORTHOFER & VESSELY. 1990) and (SCHULZE et al.. 1988) as well as measurements of emissions of a tractor engine by FTU (FTU. 2000) were applied.

HCB emissions were calculated on the basis of dioxin emissions and assuming a factor of 200.

For coal fired steam locomotives the same emission factor as for 1 A 4 b – stoves were used.

Table 204: POP emission factors for Sector 1 A 3 Transport and SNAP 08 Off-Road Machinery.

	PCDD/F EF [µgTE/GJ]	PAK4 [mg/GJ]
Passenger cars. gasoline	0.046	5.3
PC. gasoline. with catalyst	0.0012	0.32
Passenger cars. diesel	0.0007	6.4
LDV	0.0007	6.4
HDV	0.0055	6.4
Motorcycles < 50 ccm	0.0031	21
Motorcycles < 50 ccm with catalyst	0.0012	2.1
Motorcycles > 50 ccm	0.0031	33
Coal fired steam locomotives	0.38	0.085

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[113] Emissions from off-road machinery are reported under 1 A 2 f (machinery in industry), 1 A 4 b (machinery in household and gardening) and 1 A 4 c (machinery in agriculture/forestry/fishing).

3.3.13.3 Emission factors for PM used in NFR 1 A 3

As already described in Chapter 3.3 the emission inventories of PM for different years were prepared by contractors and incorporated into the inventory system afterwards.

PM emissions from tyre and brake wear are included in road abrasion and it is not possible to develop separate emission factors (by road and vehicle type) from field emission measurements which consider total vehicle emissions.

3.4 NFR 1 B Fugitive Emissions

Fugitive Emissions arise from the production and extraction of coal, oil and natural gas; their storage, processing and distribution. These emissions are fugitive emissions and are reported in NFR Category 1 B. Emissions from fuel combustion during these processes are reported in NFR Category 1 A.

3.4.1 Completeness

Table 205 gives an overview of the NFR categories included in this chapter and on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated.

Table 205: Overview of sub categories of Category 1 B Fugitive Emissions and status of estimation.

NFR Category		**Status**													
		NEC gas				**CO**	**PM**			**Heavy metals**			**POPs**		
		NO_x	**SO_x**	**NH_3**	**NMVOC**	**CO**	**TSP**	**PM10**	**PM2.5**	**Cd**	**Hg**	**Pb**	**PCDD/F**	**PAH**	**HCB**
1 B 1 a	Coal Mining and Handling	NA	NA	NA	✓	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
1 B 1 b	Solid fuel transformation(1)	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
1 B 1 c	Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1 B 2 a	i Exploration, Production, Transport	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	iv Refining/Storage	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	v Distribution of oil products	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 b	Natural gas	NA	✓	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1 B 2 c	Venting and flaring(2)	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
1 B 3	Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

(1) included in 1 A 2 a Iron and Steel

(2) included in 1 A 1 b Petroleum Refining

3.4.2 NFR 1 B 1 a Coal mining and handling - Methodological issues

In this category NMVOC emissions from coal mining and handling and TSP, PM$_{10}$ and PM$_{2.5}$ emissions from storage of solid fuels, including coke oven coke, bituminous coal and anthracite, lignite and brown coal, are considered.

NMVOC emissions were calculated based on activity data available in national statistics and reports (e.g. a report on mining by the Federal Ministry of Economy, Family and Youth (BMWFJ 2012) and the tier 2 emission factor for surface mines given in the EMEP/EEA air pollutant emission inventory guidebook (EEA 2009). Before coal mining was stopped in 2007 (BMWFJ 2008) emissions decreased sharply (80 %) between 2003 and 2004.

TSP, PM$_{10}$ and PM$_{2.5}$ emissions were calculated with the simple CORINAIR methodology. Activity data were taken from the national energy balance and are presented in Table 206 together with the national emission factors. The emission factors from the national study Winiwarter et al. 2001 were converted by multiplying the emission factor with the respective net calorific value (Bituminous coal/Anthracite: 29.07 GJ/t, Lignite/Brown coal 10 GJ/t, Coke oven coke 29 GJ/t) to obtain emission factors in kg/Gg.

Table 206: Emission factors and activity data for fugitive TSP, PM$_{10}$ and PM$_{2.5}$ and NMVOC emissions from NFR category 1B1a.

	Storage of solid fuels			Coal Mining and Handling
PM	**Bituminous coal/Anthracite**	**Lignite/Brown coal**	**Coke oven coke**	**Coal Mining**
		EF [kg/Gg]		**EF [g/Mg]**
TSP	100	86	110	
PM10	47	40	52	
PM2.5	15	12	17	
NMVOC				200
Year		**Activity [Gg]**		**Activity [Gg]**
1990	1 822	2 503	2 402	2 448
1995	1 484	1 743	2 354	1 298
2000	1 848	1 381	2 435	1 255
2001	2 040	1 630	2 320	1 194
2002	1 942	1 561	2 589	1 412
2003	2 411	1 653	2 481	1 152
2004	2 426	1 215	2 443	235
2005	2 150	1 274	2 733	6
2006	2 345	757	2 783	7
2007	2 377	95	2 736	NO
2008	2 156	89	2 715	NO
2009	1 570	81	2 128	NO
2010	1 897	83	2 567	NO
2011	1 993	92	2 576	NO

3.4.1 NFR 1 B 2 a Oil - Methodological issues

As all oil fields are combined oil and gas production fields total NMVOC emissions of combined oil and gas production are reported in this category. Further in this category, NMVOC emissions of transport and distribution of oil products as well as from oil refining are considered.

Activity data for and NMVOC emissions from natural gas extraction are reported from „Fachverband Mineralöl" (Austrian association of oil industry). NMVOC emissions are reported from 1992 onwards, for the years before the emission value of 1992 was used.

Emissions and activity data for refinery dispatch stations, transport and depots and from service stations and refuelling of cars (petrol) were reported directly from „Fachverband Mineralöl" (Austrian association of oil industry). Activity data for oil refining (crude oil refined) were taken from national statistics. An implied emission factor was calculated on the basis of emission and activity data. Activity data and implied emission factors are presented in Table 207.

NMVOC emissions from refinery dispatch stations, transport and depots and from service stations and refuelling of cars decreased remarkably (89 %, 92 % and 75 % respectively) between 1990 and 2011 due to installation of gas recovery units.

NMVOC emissions from oil refining and gas extraction also showed a notabale decrease of 89 % and 55 % respectively between 1990 and 2011. This emission reduction has been achieved through technical improvements (e.g. improved tanks and loading units).

Table 207: Activity data and implied emission factors for fugitive NMVOC emissions from NFR Category 1B2a.

Year	Refinery dispatch station	Transport and depots	Service stations	Petrol	Gas extraction		Oil refining	
	IEF [g/Mg] NMVOC	IEF [g/Mg] NMVOC	IEF [g/Mg] NMVOC	Activity [Gg]	IEF [g/1000m3] NMVOC	Natural gas extracted [1000m3]	IEF [g/Mg] NMVOC	Crude oil refined [Gg]
1990	1 109	995	736	2 554	849	248 090	472	7 952
1995	916	986	662	2 402	676	405 638	174	8 619
2000	811	241	270	1 980	525	358 357	168	8 240
2001	296	238	269	1 998	485	393 492	62	8 799
2002	281	264	270	2 142	468	347 513	62	8 947
2003	269	233	270	2 223	465	408 198	62	8 819
2004	262	215	270	2 133	472	373 099	59	8 442
2005	205	206	205	2 730	557	338 349	58	8 813
2006	221	233	270	1 992	501	402 990	59	8 553
2007	228	233	270	1 966	284	444 029	60	8 539
2008	183	246	270	1 835	289	372 406	58	8 710
2009	186	151	270	1 842	300	466 628	57	8 286
2010	171	129	270	1 821	288	397 132	55	7 719
2011	181	118	270	1 756	295	375 168	50	8 170

3.4.2 NFR 1 B 2 b Natural Gas - Methodological issues

In this category SO_2 emissions from the first treatment of sour gas and NMVOC gas distribution networks are considered.

SO_2 emissions from and activity data for the first treatment of sour gas are reported from „Fachverband Mineralöl" (Austrian association of oil industry). The drop in SO_2 emissions after 1996 is due to the implementation of pollution control measures.

NMVOC emissions from gas distribution networks were calculated by applying the country-specific share of 1.2 % NMVOC in natural gas. This share is based on the natural gas composition in Austrian. Emissions were directly linked to CH_4 emissions that were calculated applying a tier 3 method based on the material specific distribution pipeline lengths (reported by "Fachverband der Gas- und Wärmeversorgungsunternehmungen", "Association of Gas- and District Heating Supply Companies") and material specific emission factors (Wartha 2005).

Table 208: Activity data and implied emission factors for fugitive NMVOC and SO_2 emissions from NFR Category 1B2b.

Year	First treatment desulfuration		Gas distribution	
	IEF [g/1000 m^3] SO_2	Raw gas Throughput [1000 m^3]	IEF [g/km] NMVOC	Distribution mains [km]
1990	8 062	248 090	2 043	11 672
1991	4 547	285 901	1 826	12 700
1992	5 600	357 135	1 722	13 893
1993	6 529	321 653	1 540	15 178
1994	3 521	363 582	1 355	16 589
1995	3 772	405 638	1 248	17 778
1996	8 776	136 737	1 149	18 995
1997	165	406 177	1 045	20 219
1998	114	367 195	980	21 339
1999	406	352 318	916	22 701
2000	405	358 357	864	24 099
2001	402	393 492	829	25 042
2002	397	347 513	833	24 216
2003	367	408 198	797	25 699
2004	386	373 099	744	26 158
2005	393	338 349	724	26 958
2006	414	402 990	713	27 413
2007	412	444 029	696	27 945
2008	438	372 406	682	28 348
2009	512	466 628	673	28 533
2010	579	397 132	662	28 733
2011	618	375 168	659	29 023

3.4.3 Recalculations

NMVOC emissions from coal mining have been included in the 2012 Austrian air emission inventory. The inclusion of NMVOC emissions from coal mining leads only to a minor increase in the national total and concerns only historic years since coal mining stopped in Austria in 2007 (BMWFJ 2008).

Emissions of TSP, PM_{10} and $PM_{2.5}$ have been recalculated due to small adaptaions in the net calorific value used for the conversion of the emission factor from g/GJ to kg/Gg.

4 INDUSTRIAL PROCESSES (NFR SECTOR 2)

4.1 Sector overview

This chapter includes information on the estimation of the emissions of NEC gases, CO, particle matter (PM), heavy metals (HM) and persistent organic pollutant (POP) as well as references for activity data and emission factors reported under NFR Category *2 Industrial Processes* for the period from 1990 to 2010 in the NFR.

Emissions from this category comprise emissions from the following sub categories:

- Mineral Products
- Metal Production
- Chemical Industry
- Other Production (Chipboard and Food and Drink)

Only process related emissions are considered in this Sector, emissions due to fuel combustion in manufacturing industries are allocated in NFR Category *1 A 2 Fuel Combustion – Manufacturing Industries and Construction* (see Chapter 3.1.4).

Some categories in this sector are not occurring (NO) in Austria as there is no such production. For some categories emissions are included elsewhere (IE). In Chapter 1.7 and Chapter 4.2.3 a general and sector specific, respectively description regarding completeness is given.

4.2 General description

4.2.1 Methodology

The general method for estimating emissions for the industrial processes sector involves multiplying production data for each process by an emission factor per unit of production (CORINAIR simple methodology).

In some categories emission and production data were reported directly by industry or associations of industries and thus represent plant specific data.

4.2.2 Quality Assurance and Quality Control (QA/QC)

For the Austrian Inventory there is an internal quality management system, for further information see Chapter 1.5. Concerning measurement and documentation of emission data there are also specific regulations in the Austrian legislation as presented in Table 209. This legislation also addresses verification. Some plants that are reporting emission data have quality management systems implemented according to the ISO 9000–series or to similar systems.

Table 209: Austrian legislation with specific regulations concerning measurement and documentation of emission data.

IPCC Source Category	Austrian legislation
2 A 1	BGBl 1993/63 Verordnung für Anlagen zur Zementerzeugung
2 A 7	BGBl 1994/498 Verordnung für Anlagen zur Glaserzeugung
2 C 1	BGBl 1994/447 Verordnung für Gießereien
2 C 1	BGBl II 1997/160 Verordnung für Anlagen zur Erzeugung von Eisen und Stahl
2 C 1	BGBl II 1997/163 Verordnung für Anlagen zum Sintern von Eisenerzen
2 A/2 B/2 C/2 D	BGBl II 1997/331 Feuerungsanlagen-Verordnung
2 C 2/2 C 3/2 C 5	BGBl II 1998/1 Verordnung zur Erzeugung von Nichteisenmetallen
2 A/2 B/2 C/2 D	BGBl 1988/380 Luftreinhaltegesetz für Kesselanlagen
2 A/2 B/2 C/2 D	BGBl 1989/19 Luftreinhalteverordnung für Kesselanlagen

Extracts of the applicable paragraphs are provided in Annex 3.

4.2.3 Completeness

Table 210 gives an overview of the NFR categories included in this chapter. A "✓" indicates that emissions from this sub category have been estimated.

Some categories in this sector are not occurring (NO) in Austria as there is no such production. For some categories emissions have not been estimated (NE) for the years 1980-1999 or are included elsewhere (IE). In Chapter 1.7 and Chapter 4.2.3 a general and sector specific, respectively description regarding completeness is given.

Table 210: Overview of sub categories of Category 2 Industrial Processes.

NFR Category		Status													
		NEC gas				CO	PM			Heavy metals			POPs		
		NO_x	SO_2	NH_3	NMVOC	CO	TSP	PM10	PM2.5	Cd	Hg	Pb	Dioxin	PAH	HCB
2 A 1	Cement Production	NA	NA	NA	NA	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
2 A 2	Lime Production	NA	NA	NA	NA	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
2 A 3	Limestone and Dolomite Use	NA	NA	NA	NA	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
2 A 4	Soda Ash Production and use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 A 5	Asphalt Roofing	NA	NA	NA	IE(1)	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 A 6	Road Paving with Asphalt	NA	NA	NA	IE(1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 A 7	Other including Non Fuel Mining & Construction	NA	NA	NA	NA	NA	✓	✓	✓	NA	NA	NA	NA	NA	NA
2 B 1	Ammonia Production	✓	NA	✓	IE(2)	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 B 2	Nitric Acid Production	✓	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 B 3	Adipic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2 B 4	Carbide Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 B 5	Other	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	✓ (3)	✓ (4)

NFR Category		Status													
		NEC gas				CO	PM			Heavy metals			POPs		
		NO_x	SO_2	NH_3	NMVOC	CO	TSP	PM10	PM2.5	Cd	Hg	Pb	Dioxin	PAH	HCB
2 C	METAL PRODUCTION	✓	✓	IE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2 D 1	Pulp and Paper	✓	NA	NA	✓	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA
2 D 2	Food and Drink	NA	NA	NA	✓	NA	✓	✓	✓	NA	NA	NA	✓	✓	✓
2 G	OTHER	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

(1) *included in 3 Solvent and other Product use*

(2) *included in 2 B 5 Other*

(3) *until 2001 from Graphite Production; later NO*

(4) *until 1992 from Tri-, Perchlorethylene Production; later NO*

4.3 NFR 2 A Mineral Products

4.3.1 Fugitive Particular Matter emissions

4.3.1.1 Source Category Description

In this category fugitive PM emissions from bulk material handling are reported. These include emissions from quarrying and mining of minerals other than coal, construction and demolition and agricultural bulk materials. Most of these emissions are reported in NFR category 2 A 7, except emissions from cement that are reported in NFR category 2 A 1, from lime that are reported in NFR category 2 A 2, and from agricultural bulk material that are reported in NFR category 4 D 2. Emissions from cement and lime production include point source emissions from kilns.

4.3.1.2 Methodological Issues

The general method for estimating fugitive particular matter emissions involves multiplying the amount of bulk material by an emission factor (CORINAIR simple methodology). All emission factors were taken from a national study (WINIWARTER et al. 2001) and partly updated or amended by (WINIWARTER et al. 2007). The latter includes

- new emission factors for handling bulk materials and updated methodology according to VDI[114] guidelines 3790;
- the inclusion of PM emissions from cement and limestone kilns from 1 A 2 f Other Industry under 2 A 1 and 2 A 2;
- and updated methodology and emission factors for Construction and demolition based on CEPMEIP (2002)[115].

In 2011, a new confidential study was published by the Association for Building Materials and Ceramic Industries, which contained a new EF for PM 10 for limestone (AMANN & DÄMON, 2011). The calculation was based on the evaluation of 20 studies, comparing different quarries, also for

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[114] Association of German Engineers – VDI Verein Deutscher Ingenieure

[115] http://www.air.sk/tno/cepmeip/em_factors_results.php?

dolomite and basaltic rocks. It showed that the EF can be used for all three kinds of material. For the calculation of emission factors for PM2.5 and TSP, the relation TSP 100%, PM10 46.51%, PM2.5 4.65% was used (WINIWARTER et al. 2007). For data before 2000, EFs were calculated based on the same theory, but based on the EF for dolomite based on the study by HÖFINGER & TRENKER (2001).

Emission factors are presented in Table 211. Activity data are mainly taken from national statistics and presented in Table 212.

Table 211: Emission factors (EF) for diffuse PM emissions from bulk material handling.

Bulk material	**EF TSP [g/t]**	**EF PM10 [g/t]**	**EF PM2.5 [g/t]**
Magnesite (1)	216.20	101.61	10.81
Sand (1)	525.00	246.75	26.25
Gravel (1)	135.00	63.45	6.75
Silicates (1)	191.00	89.77	9.55
Dolomite (3)	141.90	66.00	6.60
Limestone (3)	141.90	66.00	6.60
Basaltic rocks (3)	141.90	66.00	6.60
Iron ore	216.78	104.70	30.43
Tungsten ore	25.12	11.86	3.75
Gypsum, Anhydride (1)	85.60	40.23	4.28
Lime (1)	122.70	110.43	79.76
Cement (1)(2)	11.4 (21.8)(41.9)	10.3 (19.6)(37.7)	9.2 (17.4)(33.5)
Cement & Lime milling	7.75	6.98	6.20
Rye flour	43.59	20.62	6.50
Wheat flour	43.59	20.62	6.50
Sunflower and rapeseed grist	24.76	11.85	3.79
Wheat bran and grist	10.90	5.16	1.63
Rye bran and grist	10.90	5.16	1.63
Concentrated feedingstuffs	30.28	14.32	4.51
Bulk material	**EF TSP [g/m^2]**	**EF PM10 [g/m^2]**	**EF PM2.5 [g/m^2]**
Construction and demolition (1)	173.40	86.70	8.67

(1) Source: WINIWARTER et al. 2007

(2) decreasing EF; values given for 2011 (2006)(1990)

(3) Source: Amann & Dämon 2011

Table 212: Activity data for diffuse PM emissions from bulk material handling.

Activity data [t]	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**
Magnesite	1 179 162	783 497	725 832	693 754	757 063	867 912
Sand	2 517 296	3 033 907	3 692 910	3 660 228	2 001 407	1 772 496
Gravel	14 264 676	17 192 140	20 978 974	25 361 797	28 304 033	29 455 383
Silicates	1 484 527	810 520	1 991 018	2 580 295	2 593 863	2 793 705
Dolomite	1 879 837	8 789 688	7 152 245	6 291 413	3 914 859	3 710 729
Limestone	15 371 451	19 079 581	23 823 529	22 643 754	21 189 887	21 570 972

Activity data [t]	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**
Basaltic rocks	3 673 535	4 202 244	4 933 202	3 166 281	3 234 408	3 582 562
Iron ore	2 310 710	2 116 099	1 859 449	2 047 950	2 068 853	2 206 910
Tungsten ore	191 306	411 417	416 456	472 964	429 748	423 790
Gypsum, Anhydride	751 645	958 430	946 044	911 162	872 273	815 438
Lime, quick, slacked	512 610	522 934	654 437	760 464	765 231	810 275
Cement	3 693 539	2 929 973	3 052 974	3 221 167	3 097 043	3 175 642
Cement & Lime milling	2 450 000	2 450 000	2 450 000	2 450 000	2 450 000	2 450 000
Rye flour	61 427	55 846	48 054	62 387	84 997	82 350
Wheat flour	259 123	287 461	291 482	324 160	451 086	478 382
Sunflower and rapeseed grist	19 900	108 600	121 200	121 200	121 200	121 200
Wheat bran and grist	64 781	71 865	73 303	100 185	126 075	127 453
Rye bran and grist	15 357	13 962	13 139	13 139	13 139	13 139
Concentrated feeding stuff	638 014	720 972	980 808	1 018 649	988 371	1 039 233
Constructed floor space [m^2]	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**
Construction and demolition	10 142 004	11 060 799	11 788 151	12 635 694	15 523 089	16 508 519

4.3.2 NFR 2 A 5 Asphalt Roofing

4.3.2.1 Source Category Description

In this category CO emissions from the production of asphalt roofing are considered. CO emissions of this category are an important CO source from NFR Category *2 Industry*: in 2010 41% of all industrial process CO emissions originated from this category.

NMVOC emissions previously reported under this category resulted from the production and laying of asphalt roofing. However, these emissions are already accounted for in the solvents sector, that's why emissions are now reported as "IE".

4.3.2.2 Methodological Issues

CO emissions from asphalt roofing were calculated by multiplying an emission factor of 350 g CO/m^2 produced asphalt roofing (BUWAL 1995) with activity data (roofing paper produced). The consumption of bitumen was assumed to be 1.2 kg/m^2 of asphalt roofing. Activity data were taken from national statistics (Statistik Austria).

Table 213: Activity data for CO emissions from asphalt roofing.

	1990	**1995**	**2000**	**2005**	**2008**	**2009**	**2010**	**2011**
Asphalt roofing [m^2]	27 945 000	31 229 000	26 020 734	27 952 613	27 952 613	27 952 613	27 952 613	27 952 613

4.3.3 NFR 2 A 6 Road Paving with Asphalt

NMVOC emissions previously reported under this category resulted from road paving with asphalt. However, these emissions are already accounted for in the solvents sector, that's why emissions are now reported as "IE".

4.3.4 Recalculations

2 A Mineral Products - Fugitive Particular Matter emissions: recalculations were made due to the implementation of the new confidential study (AMANN & DÄMON, 2011).

4.4 NFR 2 B Chemical Products

4.4.1 NFR 2 B 1 and 2 B 2 Ammonia and Nitric Acid Production

4.4.1.1 Source Category Description

Ammonia (NH_3) is produced by catalytic steam reforming of natural gas or other light hydrocarbons (e.g. liquefied petroleum gas, naphtha). Nitric acid (HNO_3) is manufactured via the reaction of ammonia (NH_3) whereas in a first step NH_3 reacts with air to NO and NO_2 and is then transformed with water to HNO_3. Both processes are minor sources of NH_3 and NO_x emissions. During ammonia production also small amounts of CO are emitted.

In Austria there is only one producer of ammonia and nitric acid.

The following process chart Figure 25 shows the scheme of ammonia synthesis: the main production lines (ammonia, urea, melamine, nitric acid, fertiliser etc.) with their main raw material as well their internal subsequent processing of related products (UMWELTBUNDESAMT (2004d).[116]

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[116] UMWELTBUNDESAMT (2004d): Schindler I., Kutschera U., Wiesenberger H.: Medienübergreifende Umweltkontrolle in ausgewählten Gebieten. Wien.

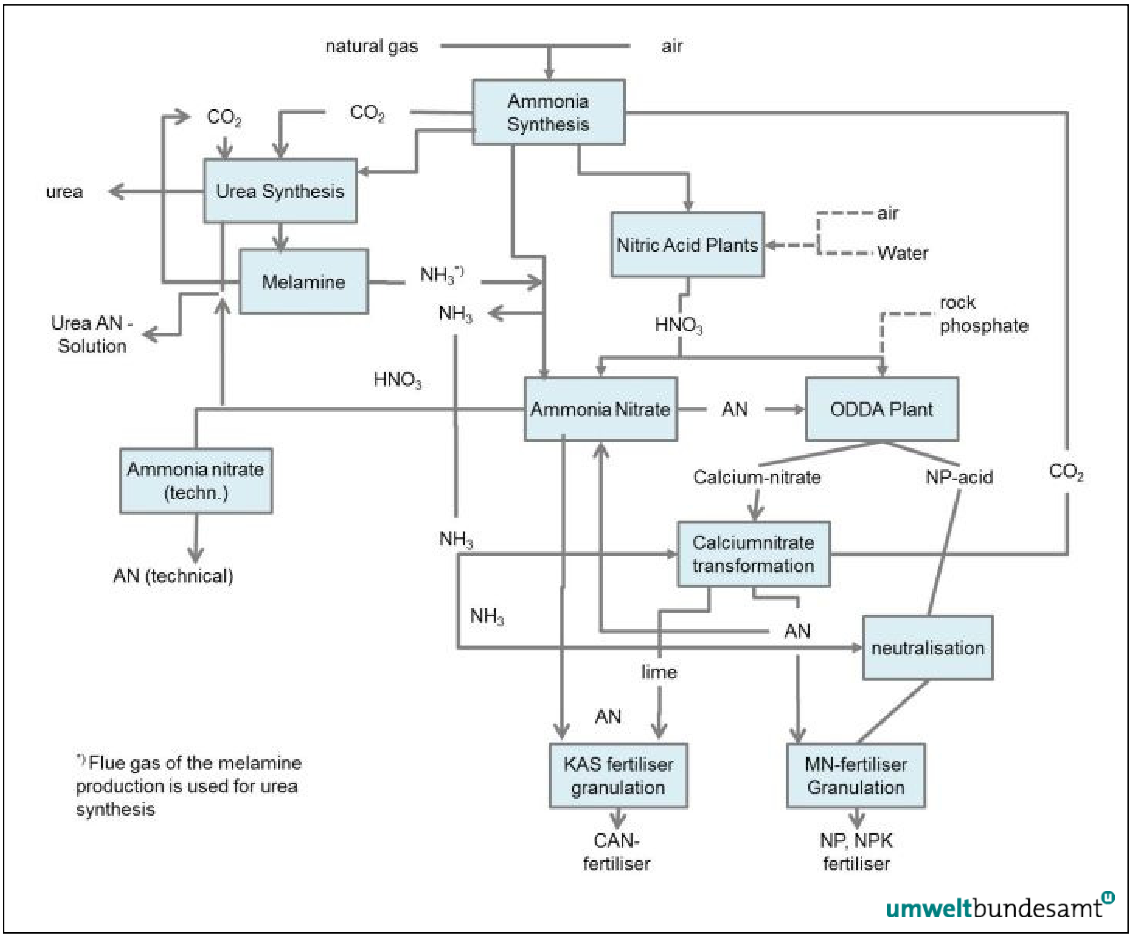

Figure 25: Scheme of ammonia synthesis

4.4.1.2 Methodological Issues

Activity data since 1990 and emission data from 1994 onwards were reported directly to the UMWELTBUNDESAMT by the only producer in Austria and thus represent plant specific data. From emission and activity data an implied emission factor (IEF) was calculated (see Table 214 and Table 215). The implied emission factor (IEF) that was calculated from activity and emission data from 1994 was applied to calculate emissions of the year 1993 for NO_x emissions and for the years 1990 to 1993 for NH_3 and CO emissions, as no emission data was available for these years. NO_x emissions in 2009 decreased significantly, this is due to a change of combustion temperature in the plant which results in a decrease of emissions. In 2010 emissions increased again due to process intrinsic fluctuations, but in 2011 the emission decreased by 7 % due to a more stable process.

NO_x emissions from 1990 to 1992 are reported in category *2 B 5 Other processes in organic chemical industries.*

NH_3 emission factors vary depending on the plant utilization and on how often the production process was interrupted, e.g. because of change of the catalyst. The decrease of IEF and emissions in 2010 and 2011 is due to a new catalyst used for N_2O.

Table 214: Emissions and implied emission factors for NO_x, NH_3 and CO from Ammonia Production (NFR Category 2 B 1).

Year	NO_x emission [Mg]	NO_x IEF [g/Mg]	NH_3 emission [Mg]	NH_3 IEF [g/Mg]	CO emission [Mg]	CO IEF [g/Mg]
1990	IE	NA	7.4	16.00	123.1	267.1
1991	IE	NA	7.6	16.00	126.9	267.1
1992	IE	NA	6.9	16.00	115.4	267.1
1993	470.8	1 003.8	7.5	16.00	125.3	267.1
1994	445.7	1 003.8	7.1	16.00	118.6	267.1
1995	285.9	604.44	10.7	22.62	95.1	201.1
1996	284.8	587.49	12.3	25.37	62.7	129.3
1997	292.1	608.92	10.9	22.72	128.4	267.7
1998	250.6	517.29	4.2	8.67	84.3	174.0
1999	232.1	473.20	8.5	17.33	41.1	83.8
2000	206.5	428.13	7.0	14.51	43.0	89.2
2001	203.7	454.51	6.0	13.39	41.0	91.5
2002	224.8	484.45	11.1	23.92	30.5	65.7
2003	226.7	443.74	11.3	22.12	26.0	50.9
2004	231.1	453.12	9.6	18.82	42.5	83.3
2005	244.0	509.94	9.9	20.69	52.6	109.9
2006	215.1	428.24	13.3	26.48	75.2	149.7
2007	177.0	401.09	24.0	54.38	83.9	190.1
2008	224.0	457.96	12.1	24.74	46.1	94.2
2009	128.9	286.83	12.7	28.26	42.5	94.6
2010	197.7	399.11	10.7	21.60	56.9	114.9
2011	184.7	367.59	10.7	21.30	49.0	97.5

Table 215: Emissions and implied emission factors for NO_x and NH_3 from Nitric Acid Production (NFR Category 2 B 2).

Year	NO_x emission [Mg]	NO_x IEF [g/Mg]	NH_3 emission [Mg]	NH_3 IEF [g/Mg]
1990	IE	NA	1.4	2.6
1991	IE	NA	1.4	2.6
1992	IE	NA	1.3	2.6
1993	691	1 346.0	1.3	2.6
1994	629	1 346.0	1.3	2.8
1995	346	715.5	0.1	0.2
1996	359	724.4	0.2	0.4
1997	343	701.3	1.9	3.9
1998	363	719.0	0.3	0.6
1999	370	721.9	0.2	0.4
2000	407	761.6	0.4	0.7
2001	379	742.0	0.5	1.0
2002	366	700.2	0.6	1.1

Year	NO_x emission [Mg]	NO_x IEF [g/Mg]	NH_3 emission [Mg]	NH_3 IEF [g/Mg]
2003	383	685.9	0.4	0.7
2004	282	492.2	0.1	0.2
2005	239	428.8	0.1	0.1
2006	166	286.4	0.8	1.4
2007	135	270.3	1.6	3.2
2008	113	201.2	1.2	2.1
2009	97	194.9	1.3	2.6
2010	144	262.9	7.8	14.2
2011	121	222.9	9.1	16.8

4.4.2 NFR 2 B 5 Chemical Products – Other

4.4.2.1 Source Category Description

This category includes NH_3 emissions from the production of ammonium nitrate, fertilizers and urea as well as NO_x emissions from fertilizers. NO_x emissions from inorganic chemical processes for the years 1990 to 1992 are reported as a sum under this category.

This category furthermore includes SO_2 and CO emissions from inorganic chemical processes and NMVOC emissions from organic chemical processes, which were not further splitted in sub categories.

Emissions of minor importance are

- Heavy Metals and Particular Matter from fertilizers;
- PAH emissions from graphite production (2002 cessation of production);
- Hg emissions from Chlorine production (1999 changeover from mercury cell to membrane cell, thus nor more emissions);
- HCB emissions from the production of Per- and Trichloroethylene (1992 cessation of production) and
- Particular matter emissions from the production of ammonium nitrate.

4.4.2.2 Methodological Issues

Ammonium nitrate and Urea production

For ammonium nitrate and urea production activity data since 1990 and emission data from 1994 onwards were reported directly to the Umweltbundesamt by the only producer in Austria and thus represent plant specific data.

The implied emission factors for NH_3 and CO that were calculated from activity and emission data of 1994 were applied to calculate emissions of the years 1990 to 1993 as no emission data was available for these years.

TSP emissions are reported directly to the Umweltbundesamt by the only producer in Austria and thus represent plant specific data. The shares of PM10 and PM2.5 are according to UMWELTBUNDESAMT (2001c) until 1996 90% and 80% (conventional plant) and from 1997 onwards 95% and 90% (modern plant).

Table 216: TSP, PM10, PM2.5 emissions and emissions and implied emission factors for and NH_3 from Ammonium nitrate.

Year	NH_3 emission [Mg]	NH_3 IEF [g/Mg]	TSP emission [Mg]	PM10 emission [Mg]	PM2.5 emission [Mg]
1990	0.71	72.39	12.80	11.52	10.24
1991	1.05	72.39	NE	NE	NE
1992	0.78	72.39	NE	NE	NE
1993	0.84	72.39	NE	NE	NE
1994	0.30	24.31	12.80	11.52	10.24
1995	0.90	72.39	14.90	13.41	11.92
1996	0.40	27.67	9.80	8.82	7.84
1997	0.30	21.87	0.40	0.38	0.36
1998	0.30	21.44	0.30	0.28	0.27
1999	0.30	20.67	0.40	0.38	0.36
2000	0.20	12.89	0.20	0.19	0.18
2001	0.30	20.41	0.30	0.28	0.27
2002	0.48	29.01	0.20	0.19	0.18
2003	0.43	24.08	0.30	0.29	0.27
2004	0.40	21.47	0.20	0.19	0.18
2005	0.33	17.20	0.26	0.24	0.23
2006	0.43	21.85	0.30	0.28	0.27
2007	0.53	26.28	0.30	0.29	0.27
2008	0.34	22.18	0.20	0.19	0.18
2009	0.30	22.59	0.40	0.38	0.36
2010	0.30	23.08	0.20	0.19	0.18
2011	0.20	17.93	0.10	0.10	0.09

Table 217: Emissions and implied emission factors for NH_3 and CO from Urea production.

Year	NH_3 emission [Mg]	NH_3 IEF [g/Mg]	CO emission [Mg]	CO IEF [g/Mg]
1990	38.6	137.0	7.1	25.0
1991	40.4	137.0	7.4	25.0
1992	35.5	137.0	6.5	25.0
1993	41.8	137.0	7.6	25.0
1994	49.3	137.0	9.0	25.0
1995	47.7	121.4	9.7	24.7
1996	30.4	72.8	9.8	23.5
1997	27.9	71.2	9.1	23.2
1998	38.8	98.2	9.5	24.0
1999	33.1	81.1	6.6	16.2
2000	17.4	44.6	3.6	9.2
2001	14.4	39.2	3.6	9.8
2002	24.6	63.1	3.6	9.2

Year	NH_3 emission [Mg]	NH_3 IEF [g/Mg]	CO emission [Mg]	CO IEF [g/Mg]
2003	35.7	79.8	4.0	8.9
2004	26.3	59.5	3.7	8.4
2005	30.1	72.3	3.8	9.1
2006	25.2	58.7	3.8	8.9
2007	31.8	82.7	3.4	8.8
2008	29.4	70.0	3.7	8.8
2009	39.9	99.6	3.7	9.2
2010	33.8	80.5	3.7	8.8
2011	41.1	96.3	3.6	8.4

Fertilizer production

For fertilizer production activity data from 1990 to 1994 were taken from national production statistics[117] (STATISTIK AUSTRIA); NO_x and NH_3 emissions and activity data from 1995 onwards were reported by the main producer in Austria. For the years 1990 to 1993 NH_3 emissions were estimated with information on emissions of the main producer and extrapolation to total production. The emission estimate for 1994 was obtained by applying the average emission factor of 1995–1999. NO_x emissions from 1990 to 1992 are included in *Other processes in organic chemical industries*.

Cd, Hg and Pb emissions were calculated by multiplying the above mentioned activity data with national emission factors (HÜBNER 2001a), that derive from analysis of particular matter fractions as described in (MA LINZ 1995). Particular matter emissions (fugitive and non-fugitive) were estimated for the whole fertilizer production in Austria (WINIWARTER et al. 2007) for the years 1990, 1995 and 1999. Implied emission factors were calculated from emission and activity data that were used to calculate emissions from 2000 to 2005. The shares of PM10 and PM2.5 are 58.6% and 30.9% for the whole time-series.

Table 218: NO_x and NH_3 emissions from Fertilizer Production.

Year	NO_x emission [Mg]	NH_3 emission [Mg]
1990	IE	218.7
1991	IE	455.0
1992	IE	322.5
1993	87.8	165.3
1994	85.8	108.0
1995	60.0	37.2
1996	47.1	51.6
1997	48.8	59.9
1998	47.2	57.4
1999	63.3	74.4
2000	71.4	73.2
2001	74.5	56.2

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[117] This results in an inconsistency of the time series, as activity data taken from national statistics represent total production in Austria, whereas the data obtained from the largest Austrian producer covers only the production of this producer. It is planned to prepare a consistent time series.

Year	NO_x emission [Mg]	NH_3 emission [Mg]
2002	74.0	21.8
2003	77.3	26.3
2004	46.7	20.4
2005	89.4	25.4
2006	70.4	32.4
2007	25.7	17.2
2008	81.6	36.1
2009	70.4	32.1
2010	81.4	36.0
2011	76.5	37.8

Table 219: Heavy metal emission factors in Fertilizer Production.

Year	Cd EF [mg/Mg]	Hg EF [mg/Mg]	Pb EF [mg/Mg]
1990	0.67	0.08	0.84
1995	0.67	0.08	0.84
2000	0.67	0.08	0.84
2005	0.67	0.08	0.84
2006	0.67	0.08	0.84
2007	0.66	0.08	0.82
2008	0.67	0.08	0.83
2009	0.63	0.08	0.79
2010	0.62	0.08	0.78
2011	0.62	0.08	0.78

Table 220: Particular matter emissions from Fertilizer Production.

Year	TSP emission [Mg]	PM10 emission [Mg]	PM2.5 emission [Mg]
1990	945	554	292
1995	434	254	134
2000	447	262	138
2001	419	246	129
2002	443	259	137
2003	469	275	145
2004	476	279	147
2005	456	267	141
2006	477	279	147
2007	390	228	120
2008	455	267	141
2009	375	220	116
2010	459	269	142
2011	462	271	143

Other processes in organic and inorganic chemical industries

All SO_2, NO_x and NMVOC process emissions from chemical industries (both organic and inorganic) are reported together as a total in category *2 B 5 Other*. For NO_x emissions from 1993 onwards emission data has been split and allocated to the respective emitting processes (ammonia production, fertilizer production and nitric acid production).

Activity data until 1992 were taken from Statistik Austria. In the year 1997 a study commissioned by associations of industries was published (WINDSPERGER & TURI 1997). The activity Figures for the year 1993 included in this study was used for all years afterwards, as no more up to date activity data is available.

Emission data for NO_x and CO were taken from the same study (WINDSPERGER & TURI 1997); they were obtained from direct inquiries in industry. SO_2 emissions were re-evaluated by direct inquiries in industry in 2004. NMVOC emissions were re-evaluated from 1994 onwards with data reported by the Austrian Association of Chemical Industry.

Activity data and emissions for NO_x, NMVOC, CO and SO_2 from other organic and inorganic chemical industries are presented in Table 221.

Table 221: NMVOC, NO_x, SO_2 and CO emissions and activity data from other processes in organic and inorganic chemical industries.

Year	**Processes in organic chemical industries**		**Processes in inorganic chemical industries**			
	NMVOC emissions	**Activity**	**NO_x emissions**	**SO_2 emissions**	**CO emissions**	**Activity**
	[Mg]		**[Mg]**			
1990	8 285	1 130 265	4 072	1 565	12 537	963 824
1995	9 207	1 193 928	IE	712	11 064	908 640
2000	1 665	1 066 788	IE	595	11 064	908 640
2005	1 325	1 066 788	IE	766	11 064	908 640
2006	1 325	1 066 788	IE	766	11 064	908 640
2007	1 325	1 066 788	IE	766	11 064	908 640
2008	1 325	1 066 788	IE	766	11 064	908 640
2009	1 325	1 066 788	IE	766	11 064	908 640
2010	1 325	1 066 788	IE	766	11 064	908 640
2011	1 325	1 066 788	IE	766	11 064	908 640

Chlorine, Graphite and Per- and Trichloroethylene production

Hg emissions from chlorine production are calculated by multiplying production figures from industry with national emission factors (WINDSPERGER et al. 1999) that are based on (WINIWARTER & SCHNEIDER 1995). In 1999 the chlorine producing company changed the production process from mercury cell to membrane cell. Therefore, for 1999 the EF was assumed to be half of the years before and since 2000 no Hg emissions result from chlorine production.

HCB emissions and production figures from Per- and Trichloroethylene production were evaluated in a national study (HÜBNER 2001b). The emission factor used is 60 mg/Mg Product and is based on the study (UBA BERLIN 1998). Since 1993 there is no production of Per- and Trichloroethylene in Austria.

Table 222: Hg and PAH emission factors and HCB emissions from other processes in organic and inorganic chemical industries.

Year	Chlorine production	Graphite production	Per- Trichloroethylene production
	Hg EF [mg/Mg]	**PAH EF [mg/Mg]**	**HCB emissions [g]**
1990	3 000	NE	1 260
1995	2 000	NE	NO
2000	NO	NE	NO
2005	NO	NE	NO
2011	NO	NE	NO

4.4.3 Recalculations

The emission factor of PAH for graphite production was not plausible anymore; therefore this source category is NE.

4.5 NFR 2 C Metal Production

In this category emissions from iron and steel production and casting as well as process emissions from non-ferrous metal production and casting are considered.

4.5.1 NFR 2 C 1 Iron and Steel

In this category, emissions from blast furnace charging, basic oxygen furnace steel plants, electric furnace steel plants in Austria, from rolling mills and from iron casting are considered.

4.5.1.1 Blast Furnace Charging

In this category PM, POP and heavy metal emissions are considered. SO_2, NO_x, NMVOC, and CO emissions are included in category 1 A 2 a.

Heavy metal and POP emissions 1990–2000 were calculated by multiplying activity data with emission factors from unpublished national studies (Hübner 2001a[118]), (Hübner 2001b[119]) for each of the processes (sinter, coke oven, blast furnace cowpers) separately and summing up emissions. For the years 2001–2008 emissions were calculated by multiplying iron production with the implied emission factors for 2000, except dioxine emissions that were reported directly from plant operators since 2002.

Particular matter emissions for the years 1990 to 2001 were taken from a national study (Winiwarter et al. 2001[120]). The sources for these emissions are environmental declarations from the companies. For the years 2002–2011 total particular matter emissions are reported directly by the operator.

Pig iron production figures were taken from national statistics. Activity data, POP, HM and PM emissions are presented in Table 223.

Table 223: Activity data and emissions from blast furnace charging.

Year	Activity [Mg]	Emissions [kg]			Emissions [g]			Emissions [Mg]		
	Iron	Cd	Hg	Pb	PAH	DIOX	HCB	TSP	PM10	PM2.5
1990	3 444 000	342	218	26 307	341	33	7 241	6 209	4 346	1 863
1991	3 442 000	286	212	22 304	279	32	7 141	NE	NE	NE
1992	3 074 000	177	177	14 521	233	20	4 285	NE	NE	NE
1993	3 070 000	136	176	11 556	192	15	3 251	NE	NE	NE
1994	3 320 000	106	188	9 013	166	9	2 032	NE	NE	NE
1995	3 888 000	86	281	2 118	142	10	2 261	4 113	2 879	1 234
1996	3 432 000	81	246	1 975	152	9	2 089	NE	NE	NE
1997	3 972 000	87	248	2 147	153	10	2 266	NE	NE	NE
1998	4 032 000	82	218	1 978	155	10	2 111	NE	NE	NE
1999	3 912 000	90	225	2 237	158	11	2 376	4 205	2 943	1 261
2000	4 320 000	98	236	2 557	139	12	2 657	4 174	2 922	1 252
2001	4 380 000	100	239	2 592	141	12	2 694	4 232	2 963	1 270

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[118] according to European Commission IPPC Bureau (2000); MA Linz (1995)

[119] according to Hübner, C. et al. (2000); European Commission IPPC Bureau (2000); UBA Berlin (1998)

[120] according to Voest (2000)

Year	Activity [Mg]	Emissions [kg]			Emissions [g]			Emissions [Mg]		
	Iron	Cd	Hg	Pb	PAH	DIOX	HCB	TSP	PM10	PM2.5
2002	4 669 130	106	255	2 763	150	2	2 872	2 678	1 875	803
2003	4 676 740	107	255	2 768	150	1	2 877	2 645	1 852	794
2004	4 860 630	111	265	2 877	156	2	2 990	2 486	1 740	746
2005	5 457 755	124	298	3 230	176	2	3 357	2 268	1 587	680
2006	5 565 089	127	303	3 294	179	3	3 423	1 399	979	420
2007	5 887 710	134	321	3 484	189	2	3 622	772	540	232
2008	5 845 533	133	319	3 460	188	2	3 596	970	679	291
2009	4 376 368	100	239	2 590	141	1	2 692	888	621	266
2010	5 643 855	129	308	3 340	182	2	3 472	849	595	255
2011	5 821 687	133	317	3 445	187	1	3 581	931	651	279

4.5.1.2 Basic Oxygen Furnace Steel Plant

In this category POP and heavy metal emissions are considered. SO_2, NO_x, NMVOC and CO emissions are included in category 1 A 2 a. PM emissions are reported together with emissions from blast furnace charging.

Emission factors for heavy metal emissions were taken from national studies, 1990–1994 (WINDSPERGER et al. 1999[121]), 1995–2000 (HÜBNER 2001a[118]), the latest were also used for 2001–2008, and multiplied with steel production to calculate HM emissions. POP emissions were calculated by multiplying steel production with national emission factors (HÜBNER 2001b[119]).

Steel production data was taken from national production statistics, the amount of electric steel was subtracted. Activity data, POP and HM emission factors are presented in Table 224; particular matter emissions are reported together with emissions from blast furnace charging.

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[121] according to CORINAIR (1995), VAN DER MOST et.al. (1992), WINIWARTER & SCHNEIDER (1995)

Table 224: Activity data, HM and POP emission factors and PM emissions from basic oxygen furnace steel plants.

Year	Activity [Mg]	EF [mg/Mg]				EF [µg/Mg]		Emissions [Mg]		
	Steel	Cd	Hg	Pb	PAH	DIOX	HCB	TSP	PM10	PM2.5
1990	3 921 341	19	3	984	0.04	0.69	138	IE	IE	IE
1995	4 538 355	13	1	470	0.01	0.23	46	IE	IE	IE
2000	5 183 461									
2001	5 346 305									
2002	5 647 282									
2003	5 706 640									
2004	5 900 810									
2005	6 407 738									
2006	6 487 155									
2007	6 871 499									
2008	6 872 742									
2009	5 076 926									
2010	6 570 357									
2011	6 785 682									

4.5.1.3 Electric Furnace Steel Plant

Estimation of emissions from electric furnace steel plants was carried out by multiplying an emission factor with production data. In 2011, activity data became available from the Association for Mining and Steel Industry (Fachverband Bergbau-Stahl) for the years 2005–2011. The used emission factors and their sources are summarized in Table 225 together with electric steel production figures.

Table 225: Activity data and emission factors for emissions from Electric Steel Production 1990–2011.

	1990	1995	2000	2005	2009	2010	2011
Activity	370 107	453 645	540 539	622 485	587 650	637 383	688 807
Emission factor [g/Mg Electric steel production]							
SO_2	590(1)	511(3)	119(3)	40(2)			
NO_x	330(1)	295(3)	119(3)	84(2)			
NMVOC	60(1)	60(1)	60(1)	60(1)			
CO	52 000(1)	44 594(3)	7 565(3)	159(2)			
Emission factor [mg/Mg Electric steel production]							
Cd	80.0(4)	13.0(5)	13.0(5)	0.4(2)			
Hg	75.0(4)	1.0(5)	1.0(5)	1.0(5)			
Pb	4 125.0(4)	470.0(5)	470.0(5)	19.3(2)			
PAH	13.8(6)	4.6(6)	4.6(6)	4.6(6)			
Emission factor [µg/Mg Electric steel production]							
DIOX	4.2(6)	1.4(6)	1.4(6)	0.1(2)			
HCB	840.0(6)	280.0(6)	280.0(6)	20.0(2)			
Emission factor [g/Mg Electric steel production]							
TSP	610.0(7)	610.0(7)	30.0(7)	30.0(7)			
PM10	579.5(8)	579.5(8)	28.5(8)	28.5(8)			
PM2.5	549.0(9)	549.0(9)	27.0(9)	27.0(9)			

Emission factor sources:

(1) *(WINDSPERGER & TURI 1997), study published by the Austrian chamber of commerce, section industry. For NMVOC emissions it was assumed that total VOC emissions as presented in the study are composed of 10% CH_4 and 90% NMVOC (expert judgement UMWELTBUNDESAMT).*

(2) *Mean values as reported from industry (Association of Mining and Steel Industries).*

(3) *Interpolated values (expert judgement UMWELTBUNDESAMT).*

(4) *(WINDSPERGER et. al. 1999[121])*

(5) *(HÜBNER 2001a[118])*

(6) *(HÜBNER 2001b[119])*

(7) *(EMEP/CORINAIR EMISSION INVENTORY GUIDEBOOK 2006)*

(8) *Expert judgement: 95% TSP*

(9) *Expert judgement: 90% TSP*

4.5.1.4 Rolling Mills

The emission factor for VOC emissions from rolling mills was reported directly by industry and thus represents plant specific data. It was assumed that VOC emissions are composed of 10% CH_4 and 90% NMVOC (expert judgement UMWELTBUNDESAMT) resulting in an emission factor of 0.9 g NMVOC/Mg steel produced.

Steel production data was taken from national production statistics, the amount of electric steel was subtracted.

Iron Cast

SO_2, NO_x, NMVOC and CO emissions were calculated by multiplying iron cast (sum of grey cast iron, cast iron and cast steel) with national emission factors. Activity data were obtained from „Fachverband der Gießereiindustrie Österreichs" (association of the Austrian foundry industry). The applied emission factors were taken from a study commissioned by the same association (Fachverband der Giessereiindustrie) and from direct information from this association.

Table 226: Emission factors and activity data for cast iron 1990–2011.

Year	Emission factors [g/Mg]				Activity [Mg]
	SO_2	NO_x	NMVOC	CO	Iron cast
1990	170	170	1 450	20 020	196 844
1995	140	160	1 260	11 590	176 486
2000	140	160	1 260	11 590	191 420
2001	130	151	1 180	10 843	192 386
2002					181 232
2003					175 856
2004					194 114
2005					196 017
2006					207 134
2007					223 108
2008					222 152
2009					138 745
2010					167 854
2011					173 012

4.5.1.5 Steel Cast

Emission factors for POP emissions were taken from a national study (Hübner 2001b). The emission factors used are 4.6 mg PAH/Mg cast iron 0.03 µg Dioxine/Mg cast iron and 6.4 µg HCB/Mg cast iron. Heavy metal emissions were calculated by multiplying national emission factors 1990–1994 (Windsperger et. al. 1999), 1995–2004 (Hübner 2001a) with the same activity data used for POP emissions. The emission factors used are 1 mg Hg/Mg cast iron, 80 mg Cd (1990: 110 mg)/Mg cast iron and 2 g Pb (1990: 4.6 g)/Mg cast iron. Activity data until 1995 is taken from a national study (Hübner 2001b). From 1996 onwards data published by the Association of the Austrian foundry industry (Fachverband der Giessereiindustrie) has been used.

Table 227: Activity data for cast steel 1990–2011.

Year	Activity [Mg]
1990	86 844
1995	107 486
2000	116 766
2001	117 355
2002	110 552
2003	107 272
2004	118 410
2005	119 570
2006	126 352
2007	136 096

Year	Activity [Mg]
2008	135 513
2009	84 634
2010	102 391
2011	105 537

Ferroalloys

An emission factor for TSP (1 kg/Mg Alloy) was taken from the CORINAIR guidebook 2009 (EEA 2009), emission factors for PM10 and PM2.5 are based on expert judgement (PM10 95% TSP, PM2.5 90%; as for electric steel production).

4.5.2 Non-ferrous Metals

In this category process emissions from non-ferrous metal production as well as from non-ferrous metal cast (light metal cast and heavy metal cast) are considered.

4.5.2.1 Non-ferrous Metals Production

Emission estimates for Non-ferrous Metal Production were taken from a study (WINDSPERGER & TURI 1997) and used for all years: 0.4 Gg SO_2, 0.01 Gg NMVOC and 0.2 Gg CO.

POP emissions from Aluminium Production were estimated in a national study (HÜBNER 2001b[122]) and were 6 090 kg PAH and 0.002 g Dioxine in 1990. Primary Aluminium production in Austria was terminated in 1992.

4.5.2.2 Non-ferrous Metals Casting

Activity data were obtained from „Fachverband der Gießereiindustrie Österreichs" (association of the Austrian foundry industry). The applied emission factors as presented below were taken from a study commissioned by the same association (FACHVERBAND der GIESSEREIINDUSTRIE) and from direct information from this association.

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[122] according to WURST, F. & C.HÜBNER (1997); UBA data base; EUROPEAN COMMISSION IPPC BUREAU (2000); NEUBACHER, F. et al. (1993)

Table 228: Emission factors and activity data for light metal cast 1990–2011.

Year	Emission factors [g/Mg]				Activity [Mg]
	SO_2	NO_x	NMVOC	CO	Light metal cast
1990	120	330	4 040	2 340	46 316
1995	10	230	1 740	880	59 834
2000	10	230	1 740	880	92 695
2001	10	170	1 289	660	100 061
2002					102 703
2003					109 147
2004					115 292
2005					109 927
2006					114 110
2007					118 215
2008					120 194
2009					92 374
2010					121 426
2011					135 375

Table 229: Emission factors and activity data for heavy metal cast 1990–2011.

Year	Emission factors [g/Mg]				Activity [Mg]
	SO_2	NO_x	NMVOC	CO	Heavy metal cast
1990	100	100	1 390	3 290	8 525
1995	80	80	1 180	2 770	10 384
2000	80	80	1 180	2 770	13 214
2001	80	80	1 180	2 770	13 285
2002					13 525
2003					14 220
2004					15 799
2005					18 456
2006					16 722
2007					15 690
2008					15 387
2009					12 394
2010					16 577
2011					15 524

4.5.3 Recalculations

No recalculations were made.

4.6 NFR 2 D Other Production

4.6.1 NFR 2 D 1 Pulp and Paper

4.6.1.1 Source Category Description

As emissions from pulp and paper production mainly arise from combustion activities, they are included in *1 A 2 Combustion in Manufacturing Industries*.

In this category NO_x, NMVOC and CO emissions from chipboard production and TSP, PM10 and PM2.5 emissions from wood-chips industry are considered.

4.6.1.2 Methodological Issues

NO_x, NMVOC and CO emissions were calculated by applying national emission factors on production data (activity data). Activity data were taken from Statistik Austria. The values of 1995, 1998 and 2005 were also used for the year after because no data is available for these years. The applied emission factors were taken from a study (WURST et al. 1994), the values of 492 g NO_x/Mg, 361 g NMVOC/Mg and 357 g CO/Mg chipboard produced is a mean value of values obtained by inquiries of different companies producing chipboards.

Table 230: Activity data for chipboard production 1990–2011.

Year	Activity [Mg]
1990	1 121 786
1995	1 194 262
2000	1 509 673
2001	1 670 903
2002	1 785 275
2003	1 136 820
2004	1 248 028
2005	2 182 251
2006	2 560 241
2007	2 560 241
2008	2 147 527
2009	1 782 448
2010	1 975 725
2011	2 061 626

The wood-chips industry includes PM emissions from supply (production) and handling of wood-chips and sawmill-by-products for the use in chipboard and paper industry and for the use in combustion plants.

Particular matter emissions were estimated in a national study (WINIWARTER et al. 2007) for the year 2001. For supply and handling for the use in industry the same values were taken for the whole time-series due to a lack of available activity data. For supply and handling for the use in combustion plants an implied emission factor was calculated with the cross consumption of wood waste in the national energy balance (STATISTIK AUSTRIA 2012c) that was applied to the whole time-series.

Table 231: Activity data and emission factors for supply (production) and handling of wood-chips and sawmill-by-products for the use in chipboard and paper industry.

		Supply (production)	**Handling**
Activity [Mg]	logs	5 600 000	
	Wood-chips and sawmill-by-products		4 800 000
Emission factor [g/Mg]	TSP	30.0	20.0
	PM10	12.0	8.0
	PM2.5	4.8	3.2

Table 232: Activity data and emissions for supply (production) and handling of wood-chips and sawmill-by-products for the use in combustion plants.

Year	**Wood waste – cross consumption [TJ]**	**Emissions [Mg]**		
		TSP	**PM10**	**PM2.5**
1990	14 671	26.84	10.74	4.30
1995	20 118	36.81	14.72	5.89
2000	33 057	60.48	24.19	9.68
2001	38 257	70.00	28.00	11.20
2002	36 031	65.93	26.37	10.55
2003	41 527	75.98	30.39	12.16
2004	42 600	77.95	31.18	12.47
2005	54 758	100.19	40.08	16.03
2006	61 775	113.03	45.21	18.09
2007	78 750	144.09	57.64	23.05
2008	86 933	159.06	63.63	25.45
2009	89 386	163.55	65.42	26.17
2010	106 467	194.81	77.92	31.17
2011	105 018	192.16	76.86	30.74

4.6.1.3 Planned Improvements

In chipboard production gas and wood dust are used as fuels. As wood dust accumulates as waste material during chipboard production it is not reported as a fuel in the energy balance, where fuel gas is reported and included in the fuel input of SNAP Category 03 *Combustion in Production Processes*.

As the used emission factor from SNAP Category 040601 Chipboard Production refers to all emissions from chipboard production but emissions due combustion of fuel gas in chipboard production are also included in SNAP 03, these emissions are double counted. However, it is not possible to separate emissions due to combustion of wood dust from gas as no detailed fuel input figures for chipboard production are available. Further investigation of this subject is planned and if possible the double count will be eliminated.

4.6.1.4 Recalculation

Update of activity data based on energy balance of 2012.

4.6.2 NFR 2 D 2 Food and Drink

4.6.2.1 Source Category Description

This category includes NMVOC emissions from the production of bread, wine, spirits and beer and PM emissions from the production of beer. Furthermore this category includes POP emissions from smokehouses.

4.6.2.2 Methodological Issues

NMVOC emissions were calculated by multiplying the annual production with an emission factor. The following emission factors were applied:

- Bread......4 200 kg_{NMVOC}/Mg_{bread}
- Wine ....65 kg_{NMVOC}/hl_{wine}
- Beer........20 kg_{NMVOC}/hl_{beer}
- Spirits .....2 000 kg_{NMVOC}/hl_{spirit}

All emission factors were taken from (BUWAL 1995) because of the very similar structures and standards of industry in Austria and Switzerland. Activity data was taken from national statistics (STATISTIK AUSTRIA), for the year 2008 no activity data was yet available, that's why the values of 2007 were also used for 2008.

PM emissions from beer production correspond to fugitive emissions from barley used for the production of malt. Emissions were estimated in a national study (WINIWARTER et al. 2001) and are:

- TSP.........1990: 2.2 Mg, 1995: 2.1 Mg, 1999–2005: 1.9 Mg
- PM10......1990: 1.1 Mg, 1995: 1.0 Mg, 1999–2005: 0.9 Mg
- PM2.5.....1990: 0.5 Mg, 1995: 0.3 Mg, 1999–2005: 0.3 Mg

POP emissions from smokehouses were estimated in an unpublished study (HÜBNER 2001b[123]) that evaluates POP emissions in Austria from 1985 to 1999. The authors of this study calculated POP emissions using technical information on smokehouses and the number of smokehouses from literature (WURST & HÜBNER 1997), (MEISTERHOFER 1986). The amount on smoked meat was also investigated by the authors of this study. From 1999 onwards the emission values from 1999 have been used as no updated emissions have been available. Activity data and emissions are presented in Table 233.

Table 233: POP emissions and activity data from smokehouses 1990–2011.

Year	Activity [Mg]	Emissions		
	Smoked meat	PAH [kg]	Diox [g]	HCB [g]
1990	15 318	545	1.8	358
1995	19 533	107	0.4	72
2000 ↓ 2011	19 533	37	0.1	26

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[123] according to MEISTERHOFER (1986)

4.6.2.3 Recalculations

Update of activity data based on national statistics.

4.6.3 NFR 2 D 3 Wood Processing

Source Category Description

This category includes TSP, PM10 and PM2.5 emissions from wood processing.

Methodological Issues

The methodology for emission calculation was developed in a national study (WINIWARTER et al. 2007) and emissions were calculated for 2001 applying emission factors of a swiss study (EMPA 2004) to Austrian activities. Two major sources are identified: the sawmill industry including wood-processing and the chipboard industry.

For sawmills and wood-processing this resulted to the following combined emission factors TSP: 149.5 g/scm; PM10: 59.8 g/scm; PM2.5: 23.92 g/scm; applied to an activity of 4 Mio solid cubic metres (scm). Due to lack of activity data these values were used for the whole time-series.

For chipboard industry emissions of 43.4 Mg TSP, 17.4 Mg PM10 and 6.9 Mg PM2.5 in the year 2001 were calculated applying the previously mentioned method. With these emissions an implied emission factor was calculated with the chipboard production from national statistics (STATISTIK AUSTRIA 2012c) that was applied to the whole time-series of chipboard production.

Table 234: Activity data and emissions for chipboard production.

Year	Chipboard production [Mg]	Emissions [Mg]		
		TSP	PM10	PM2.5
1990	1 121 786	29.12	11.65	4.66
1995	1 194 262	31.00	12.40	4.96
2000	1 509 673	39.19	15.68	6.27
2001	1 670 903	43.38	17.35	6.94
2002	1 785 275	46.34	18.54	7.42
2003	1 136 820	29.51	11.80	4.72
2004	1 248 028	32.40	12.96	5.18
2005	2 182 251	56.65	22.66	9.06
2006	2 560 241	66.46	26.58	10.63
2007	2 560 241	66.46	26.58	10.63
2008	2 147 527	71.92	28.77	11.51
2009	1 782 448	60.34	24.13	9.65
2010	1 975 725	67.29	26.92	10.77
2011	2 061 626	69.39	27.76	10.10

Recalculations

No recalculations were made.

4.7 Recalculations

Summary of Recalculations made since submission 2012 (for details refer to subchapter):

- 2 A Mineral Products - Fugitive Particular Matter emissions: recalculations were made due to the implementation of the new confidential study (AMANN & DÄMON, 2011).
- NFR 2 B 5 Chemical Products – Other: graphite production: The emission factor of PAH for graphite production was not plausible anymore; therefore this source category is NE.
- NFR 2 D 1 Pulp and Paper: Update of activity data based on energy balance of 2012.
- 2 D 2 Food and Drink: Update of activity data based on national statistics.

5 SOLVENT AND OTHER PRODUCT USE (NFR SECTOR 3)

5.1 Sector Overview

This chapter describes the methodology used for calculating greenhouse gas emissions from solvent use in Austria. Solvents are chemical compounds, which are used to dissolve substances as paint, glues, ink, rubber, plastic, pesticides or for cleaning purposes (degreasing). After application of these substances or other procedures of solvent use most of the solvents are released into air. Because solvents consist mainly of NMVOC, solvent use is a major source for anthropogenic NMVOC emissions in Austria. Once released into the atmosphere NMVOCs react with reactive molecules (mainly HO-radicals) or high energetic light to finally form CO_2.

Besides NMVOC further air pollutants from solvent use are relevant:

- Cd and Pb from NFR Sector 3 C Chemical products, manufacture and processing as well as
- PAH, dioxins and HCB from NFR Sector 3 D 2 Preservation of wood.
- PM from NFR 3 D 3 Other (Fireworek and Tobacco Smoking)

The following activities are covered by NFR sector 3:

NFR category	Description
3	SOLVENT AND OTHER PRODUCT USE
3 A	PAINT APPLICATION
3 A 1	Decorative coating application
3 A 2	Industrial coating application
3 A 3	Other coating application (Please specify)
3 B	DEGREASING AND DRY CLEANING
3 B 1	Degreasing
3 B 2	Dry cleaning
3 C	3 Chemical products
3 D	OTHER including products containing HMs and POPs
3 D 1	Printing
3 D 2	Domestic solvent use including fungicides
3 D 3	Other product use

5.1.1 Emission Trends

In the year 2011, 56.6% of total NMVOC emissions in Austria (128.17 Gg) originated from *Solvent and Other Product Use*. Table 235 present the trend in NMVOC emissions by subcategories.

Table 235: Total NMVOC emissions and trend from 1990–2011 by subcategories of Category 3 Solvent and Other Product Use.

	3	**3 A**	**3 A 1**	**3 A 2**	**3 B**	**3 B 1**	**3 B 2**	**3 C**	**3 D**	**3 D 1**	**3 D 2**	**3 D 3**
						NMVOC [Gg]						
1990	114.43	45.79	15.20	30.58	13.70	13.26	0.44	12.79	42.15	12.65	11.61	17.89
1991	96.93	37.87	12.84	25.04	11.26	10.88	0.38	10.44	37.35	10.76	11.16	15.43
1992	78.54	29.79	10.36	19.43	8.87	8.55	0.32	8.14	31.74	8.77	10.24	12.74
1993	79.91	29.21	10.51	18.70	8.79	8.45	0.34	7.95	33.97	8.97	11.77	13.22
1994	75.02	26.17	9.82	16.34	8.05	7.72	0.33	7.16	33.64	8.48	12.48	12.68
1995	81.27	26.72	10.60	16.12	8.55	8.18	0.37	7.42	38.58	9.26	15.27	14.05
1996	77.47	24.66	9.86	14.80	8.39	8.02	0.36	7.10	37.32	8.55	15.33	13.44
1997	83.48	25.70	10.36	15.34	9.29	8.88	0.40	7.68	40.82	8.90	17.38	14.54
1998	75.46	22.44	9.13	13.31	8.61	8.24	0.37	6.96	37.45	7.76	16.49	13.19
1999	69.41	19.91	8.17	11.73	8.11	7.77	0.35	6.43	34.96	6.87	15.91	12.18
2000	82.35	22.74	9.43	13.31	9.85	9.43	0.42	7.66	42.10	7.84	19.77	14.49
2001	86.90	24.08	10.00	14.08	10.69	10.25	0.44	7.94	44.18	8.05	20.74	15.39
2002	92.50	25.72	10.69	15.03	11.71	11.23	0.48	8.30	46.77	8.32	21.96	16.49
2003	93.44	26.07	10.85	15.21	12.16	11.68	0.49	8.24	46.98	8.16	22.05	16.76
2004	79.42	22.23	9.27	12.96	10.62	10.21	0.42	6.87	39.70	6.73	18.64	14.34
2005	89.20	25.04	10.46	14.59	12.25	11.78	0.47	7.57	44.34	7.32	20.81	16.20
2006	105.01	29.48	12.31	17.17	14.43	13.87	0.55	8.91	52.20	8.62	24.50	19.07
2007	95.52	26.82	11.20	15.62	13.12	12.62	0.50	8.10	47.48	7.84	22.29	17.35
2008	88.24	24.77	10.34	14.43	12.12	11.66	0.47	7.49	43.86	7.25	20.59	16.03
2009	64.27	18.04	7.53	10.51	8.83	8.49	0.34	5.45	31.95	5.28	15.00	11.67
2010	74.09	20.80	8.68	12.11	10.18	9.79	0.39	6.29	36.82	6.08	17.28	13.46
2011	72.53	20.36	8.50	11.86	9.96	9.58	0.38	6.15	36.05	5.96	16.92	13.17
Trend												
1990–2011	-36.6%	-55.5%	-44.1%	-61.2%	-27.3%	-27.8%	-12.3%	-51.9%	-14.5%	-52.9%	45.8%	-26.4%
2010–2011	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%
Share in National Total												
1990	41.8%	16.7%	5.6%	11.2%	5.0%	4.8%	0.2%	4.7%	15.4%	4.6%	4.2%	6.5%
2011	56.6%	15.9%	6.6%	9.3%	7.8%	7.5%	0.3%	4.8%	28.1%	4.6%	13.2%	10.3%

NMVOC emissions in this sector decreased by 36.6% between 1990 and 2011, due to decreasing solvent use as well as due to the positive impact of the enforced laws and regulations in Austria:

- Solvent Ordinance: limitation of emission of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products in order to combat acidification and ground-level ozone as well as the adaptation to technical progress of Annex III to Directive 2004/42/EC of the European Parliament and of the Council on the limitation of emissions of volatile organic compounds

Federal Law Gazette II Nr. 25/2013[124]*; amendment of Federal Law Gazette II No. 398/2005*[125]*, amendment of Federal Law Gazette 872/1995*[126]*; amendment of Federal Law Gazette 492/1991*[127] *(implementation of Council Directive 2004/42/CE)*

- Ordinance for paint finishing system (surface technology systems): limitation of emission of volatile organic compounds due to the use of organic solvents by activities such as surface coating, painting or varnishing of different materials and products along the entire chain in the painting process in order to combat acidification and ground-level ozone

  Federal Law Gazette 873/1995[128]*, amendment of Federal Law Gazette 27/1990*[129]

- Federal Ozone Law: establishes by various measures a reduction in emissions of ozone precursors NO_x and NMVOC

  Federal Law Gazette 309/1994; amendment of Federal Law Gazette 210/1992[130]

- Ordinance for industrial facilities and installations applying chlorinated hydrocarbon: for limitation of emission of chlorinated organic solvents from industrial facilities and installations applying chlorinated hydrocarbon

  Federal Law Gazette 865/1994[131]

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[124] Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über die Begrenzung der Emissionen flüchtiger organischer Verbindungen durch Beschränkungen des Inverkehrsetzens und der Verwendung organischer Lösungsmittel in bestimmten Farben und Lacken (Lösungsmittelverordnung 2005 – LMV 2005), BGBl. II Nr. 25/2013; Umsetzung der Richtlinie 2004/42/EG und der Richtlinie 2010/79/EU

[125] Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über die Begrenzung der Emissionen flüchtiger organischer Verbindungen durch Beschränkung des Inverkehrsetzens und der Verwendung organischer Lösungsmittel in bestimmten Farben und Lacken (Lösungsmittelverordnung 2005 – LMV 2005), BGBl. II Nr. 398/2005; Umsetzung der Richtlinie 2004/42/EG

[126] Verordnung des Bundesministers für Umwelt über Verbote und Beschränkungen von organischen Lösungsmitteln (Lösungsmittelverordnung 1995 – LMVO 1995), BGBl 872/1995

[127] Verordnung des Bundesministers für Umwelt, Jugend und Familie über Verbote und Beschränkungen von organischen Lösungsmitteln (Lösungsmittelverordnung), BGBl. Nr. 492/1991

[128] Verordnung des Bundesministers für wirtschaftliche Angelegenheiten über die Begrenzung der Emission von luftverunreinigenden Stoffen aus Lackieranlagen in gewerblichen Betriebsanlagen (Lackieranlagen-Verordnung), BGBl. Nr. 873/1995

[129] Verordnung des Bundesministers für wirtschaftliche Angelegenheiten vom 26. April 1989 über die Begrenzung der Emission von chlorierten organischen Lösemitteln aus CKW-Anlagen in gewerblichen Betriebsanlagen (CKW-Anlagen-Verordnung), BGBl. Nr. 27/1990

[130] Bundesgesetz über Maßnahmen zur Abwehr der Ozonbelastung und die Information der Bevölkerung über hohe Ozonbelastungen, mit dem das Smogalarmgesetz, BGBl. Nr. 38/1989, geändert wird (Ozongesetz)

[131] Verordnung des Bundesministers für wirtschaftliche Angelegenheiten über die Begrenzung der Emission von chlorierten organischen Lösemitteln aus CKW-Anlagen in gewerblichen Betriebsanlagen (CKW-Anlagen-Verordnung 1994), BGBl. Nr. 865/1994

- Convention on Long-range Transboundary Air Pollution (LRTAP)[132], extended by eight protocols from which the following have relevance
  - The 1988 Protocol concerning the Control of Nitrogen Oxides or their Transboundary Fluxes[133]
  - The 1991 Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes[134]
  - The 1998 Protocol on Persistent Organic Pollutants (POPs)[135]
  - The 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone; 26 Parties.[136]
- Ordinance for volatile organic compounds (VOC) due to the use of organic solvents in certain activities and installations;

  Federal Law Gazette II No. 301/2002[137], amended by Federal Law Gazette[138]
- Council Directive 1999/13/EC[139] of March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations
- Council Directive 2004/42/CE[140] of the European Parliament and of the Council of 21 April 2004 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC
- Ordinance on the limitation of emission during the use of solvents containing lightly volatile halogenated hydrocarbons in industrial facilities and installations

  Federal Law Gazette II No. 411/2005[141]

In emission intensive activity areas such as coating, painting, and printing as well as in the pharmaceutical industry several measures were implemented:

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[132] Entered into force 14 February 1991; ratified by Austria 16 December 1982

[133] Entered into force 14 February 1991; ratified by Austria 15 January 1990; BGBl. Nr. 273/1991

[134] Entered into force 29 September 1997; ratified by Austria 23 August 1994; Bekämpfung von Emissionen flüchtiger organischer Verbindungen oder ihres grenzüberschreitenden Flusses samt Anhängen und Erklärung, BGBl. III Nr. 164/1997

[135] Entered into force on 23 October 2003; ratified by Austria 27 August 2002

[136] Entered into force on 17 May 2005; signed by Austria 1 December 2000

[137] Verordnung des Bundesministers für Wirtschaft und Arbeit zur Umsetzung der Richtlinie 1999/13/EG über die Begrenzung der Emissionen bei der Verwendung organischer Lösungsmittel in gewerblichen Betriebsanlagen (VOC-Anlagen-Verordnung – VAV) BGBL II Nr. 301/2002

[138] Änderung der VOC-Anlagen-Verordnung – VAV, BGBl. II Nr. 42/2005

[139] Richtlinie 1999/13/EG des Rates vom 11. März 1999 über die Begrenzung von Emissionen flüchtiger organischer Verbindungen, die bei bestimmten Tätigkeiten und in bestimmten Anlagen bei der Verwendung organischer Lösungsmittel entstehen

[140] Richtlinie 2004/42/EG des Europäischen Rates vom 21. April 2004 über die Begrenzung von Emissionen flüchtiger organischer Verbindungen aufgrund der Verwendung organischer Lösemittel in bestimmten Farben und Lacken und in Produkten der Fahrzeugreparaturlackierung sowie zur Änderung der Richtlinie 1999/13/EG

[141] Verordnung des Bundesministers für Wirtschaft und Arbeit über die Begrenzung der Emissionen bei der Verwendung halogenierter organischer Lösungsmittel in gewerblichen Betriebsanlagen (HKW-Anlagen-Verordnung – HAV) BGBl. II Nr. 411/2005

- Primary measures
  - complete substitution of certain solvents
  - Reduction of the solvent content by changing the composition of solvent containing products
  - technological change from solvent emitting processes to low or non-solvent emitting processes
  - implementation of resources saving procedures and techniques
  - installation of new equipments and facilities and shutdown of old equipments and facilities
  - avoidance of fugitive emissions
- Secondary measures
  - Waste gas collection and waste gas purification, whereas the solvents in the exhaust air are precipitated and either recycled if applicable or destructed.
  - raising of environmental awareness
  - compliance with emission limit values for exhaust gas
  - compilation of solvent balance
  - compilation of solvent reduction plan

5.1.2 Completeness

Table 236 gives an overview of the NFR categories included in this chapter and presents the transformation matrix from SNAP categories. It also provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated.

Table 236: Overview of sub categories of NFR Category Solvent and Other Product Use: transformation into SNAP Codes and status of estimation.

NFR Category		**Status**													
		NEC gas				**CO**	**PM**			**Heavy metals**			**POPs**		
		NO_x	**SO_2**	**NH_3**	**NMVOC**	**CO**	**TSP**	**PM10**	**PM2.5**	**Cd**	**Hg**	**Pb**	**PCDD/F**	**PAK**	**HCB**
3 A	Paint application	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3 B	Degreasing and Dry Cleaning	NA	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	✓	✓	✓
3 C	Chemical Products, Manufacture and Processing	NA	NA	NA	✓	NA	NA	NA	NA	✓	NA	✓	NA	NA	NA
3 D	Other	NA	NA	NA	✓	NA	✓	✓	✓	NA	NA	NA	NA	NA	✓

5.2 NMVOC Emissions from Solvent and other product use (Category 3 A, 3 B, 3 C and 3 D 3)

5.2.1 Methodology Overview

Calculation NMVOC emissions from solvent use were done in several steps. As a first step the quantity of solvents used and the solvent emissions were calculated.

To determine the quantity of solvents used in Austria in the various applications, a bottom up and a top down approach were combined. Figure 26 to Figure 28 present an overview of the methodology.

The top down approach provided total quantities of solvents used in Austria. The share of the solvents used for the different applications and the solvent emission factors have been calculated on the basis of the bottom up approach. By linking the results of bottom up and top down approach, quantities of solvents annually used and solvent emissions for the different applications were obtained.

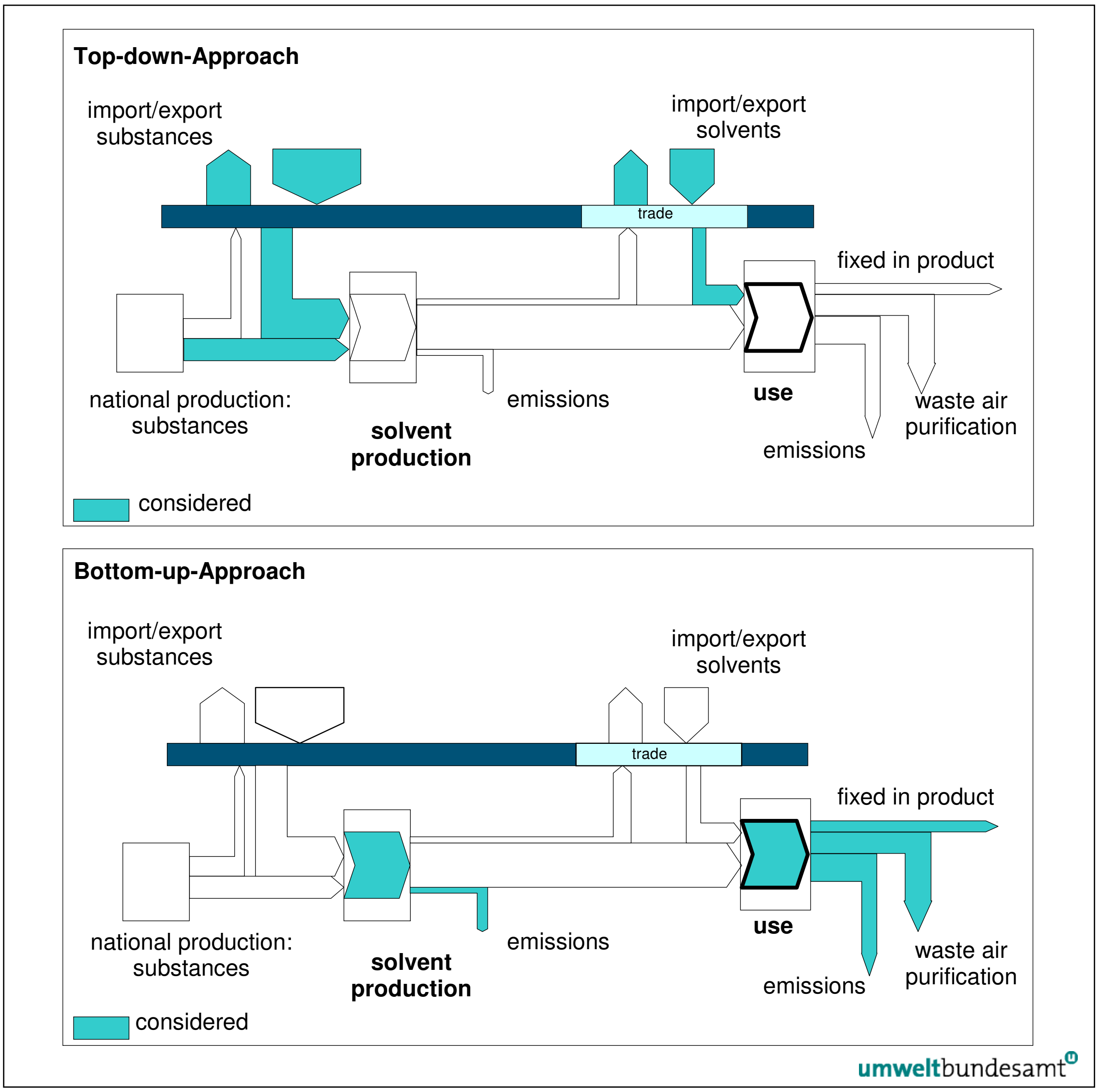
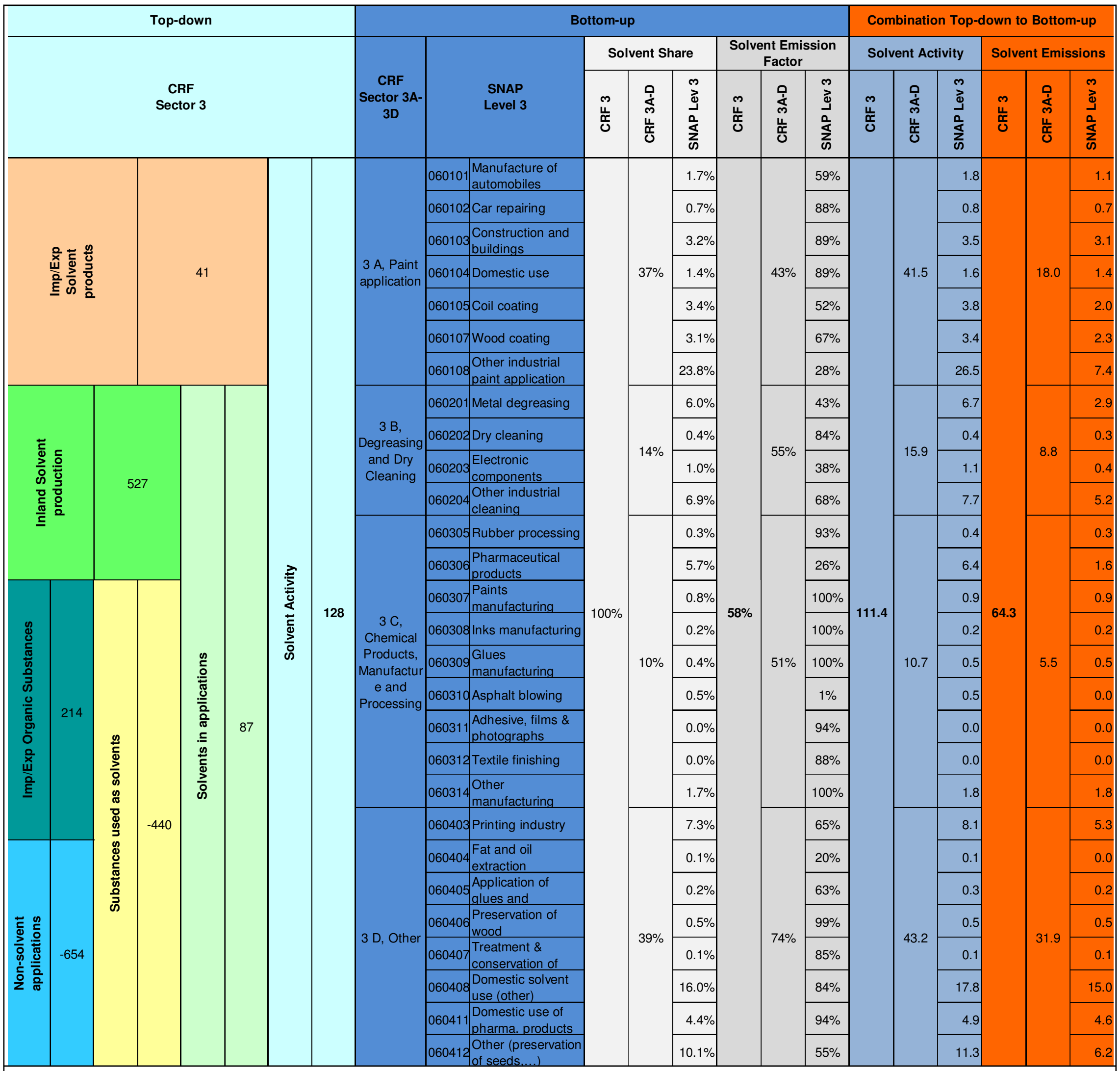


Figure 26: Top-down-Approach compared to Bottom-up-Approach.



Top-down

CRF Sector 3

Imp/Exp Solvent products 41

Inland Solvent production 527

Imp/Exp Organic Substances 214

Non-solvent applications -654

Substances used as solvents -440

Solvents in applications 87

Solvent Activity 128

Bottom-up										**Combination Top-down to Bottom-up**				
CRF Sector 3A-3D	**SNAP Level 3**		**Solvent Share**			**Solvent Emission Factor**			**Solvent Activity**			**Solvent Emissions**		
			CRF 3	**CRF 3A-D**	**SNAP Lev 3**	**CRF 3**	**CRF 3A-D**	**SNAP Lev 3**	**CRF 3**	**CRF 3A-D**	**SNAP Lev 3**	**CRF 3**	**CRF 3A-D**	**SNAP Lev 3**
3 A, Paint application	060101	Manufacture of automobiles	100%	37%	1.7%	**58%**	43%	59%	**111.4**	41.5	1.8	**64.3**	18.0	1.1
	060102	Car repairing			0.7%			88%			0.8			0.7
	060103	Construction and buildings			3.2%			89%			3.5			3.1
	060104	Domestic use			1.4%			89%			1.6			1.4
	060105	Coil coating			3.4%			52%			3.8			2.0
	060107	Wood coating			3.1%			67%			3.4			2.3
	060108	Other industrial paint application			23.8%			28%			26.5			7.4
3 B, Degreasing and Dry Cleaning	060201	Metal degreasing		14%	6.0%		55%	43%		15.9	6.7		8.8	2.9
	060202	Dry cleaning			0.4%			84%			0.4			0.3
	060203	Electronic components			1.0%			38%			1.1			0.4
	060204	Other industrial cleaning			6.9%			68%			7.7			5.2
3 C, Chemical Products, Manufacture and Processing	060305	Rubber processing		10%	0.3%		51%	93%		10.7	0.4		5.5	0.3
	060306	Pharmaceutical products			5.7%			26%			6.4			1.6
	060307	Paints manufacturing			0.8%			100%			0.9			0.9
	060308	Inks manufacturing			0.2%			100%			0.2			0.2
	060309	Glues manufacturing			0.4%			100%			0.5			0.5
	060310	Asphalt blowing			0.5%			1%			0.5			0.0
	060311	Adhesive, films & photographs			0.0%			94%			0.0			0.0
	060312	Textile finishing			0.0%			88%			0.0			0.0
	060314	Other manufacturing			1.7%			100%			1.8			1.8
3 D, Other	060403	Printing industry		39%	7.3%		74%	65%		43.2	8.1		31.9	5.3
	060404	Fat and oil extraction			0.1%			20%			0.1			0.0
	060405	Application of glues and			0.2%			63%			0.3			0.2
	060406	Preservation of wood			0.5%			99%			0.5			0.5
	060407	Treatment & conservation of			0.1%			85%			0.1			0.1
	060408	Domestic solvent use (other)			16.0%			84%			17.8			15.0
	060411	Domestic use of pharma. products			4.4%			94%			4.9			4.6
	060412	Other (preservation of seeds,...)			10.1%			55%			11.3			6.2

Source: Umweltbundesamt

Figure 27: Combination of Top-down-Approach compared to Bottom-up-Approach for submission 2012 (in Gg).

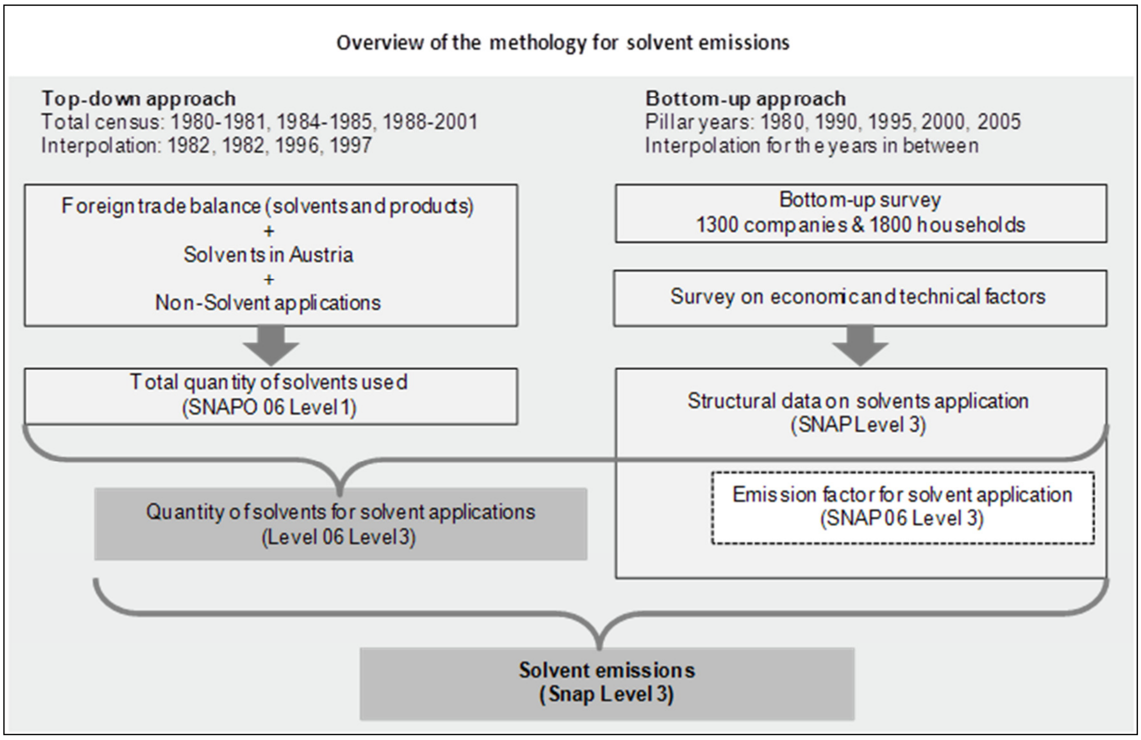


Figure 28: Overview of the methodology for solvent emissions.

A study (WINDSPERGER et al. 2002a) showed that emission estimates only based on the top down approach overestimate emissions because a large amount of solvent substances is used for "non-solvent-applications". "Non-solvent application" are applications where substances usually are used as feed stock in chemical, pharmaceutical or petrochemical industry (e.g. production of MTBE[142], ETBE[143], formaldehyde, polyester, biodiesel, pharmaceuticals etc.) and where therefore no emissions from "solvent use" arise. However, there might be emissions from the use of the produced products, such as MTBE and ETBE which is used as fuel additive and finally combusted, these emissions for example are considered in the transport sector.

Additionally the comparison of the top-down and the bottom-up approach helped to identify several quantitatively important applications like windscreens wiper fluids, antifreeze, moonlighting, hospitals, deicing agents of aeroplanes, tourism, cement- respectively pulp industry, which were not considered in the top-down approach.

5.2.2 Top-down Approach

The top-down approach is based on

1. import-export statistics (foreign trade balance)
2. production statistics on solvents in Austria
3. a survey on non-solvent-applications in companies (WINDSPERGER et al. 2004, WINDSPERGER et al. 2008)
4. survey on the solvent content in products and preparations at producers and retailers (WINDSPERGER et al. 2002a, WINDSPERGER et al. 2008)

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[142] Methyl-tertiär-butylether

[143] Ethyl-*tert*-butylether

ad (1) and (2): Total quantity of solvents used in Austria were obtained from import-export statistics and production statistics provided by STATISTIK AUSTRIA.

Nearly a full top down investigation of substances of the import-export statistics from 1980 to 2010 was carried out (data in the years 1982, 1983, 1986 and 1987 were linearly interpolated). A main problem was that the methodology of the import-export statistics changed over the years. In earlier years products and substances had been pooled to groups and whereas the current foreign trade balance is more detailed with regard to products and substances. It was necessary to harmonise the time series in case of deviations.

ad (3): In the study on the comparison of top down and bottom up approach (WINDSPERGER et al. 2002a) the amount of solvent substances used in "non-solvent-applications" was identified. The 20 most important companies in this context were identified and asked to report the quantities of solvents they used over the considered time period in "non-solvent-applications"." These companies were requested to report the quantities of used solvents for the time period 2002–2010 in "non-solvent-applications".

ad (4): Relevant producers and retailers provided data on solvent content in products and preparations. As the most important substance groups alcohols and esters were identified.

5.2.3 Bottom-up Approach

In a first step an extensive survey on the use of solvents in the year 2000 was carried out in 1 300 Austrian companies (WINDSPERGER et al. 2002b). In this survey data about the solvent content of paints, cleaning agents etc. and on solvents used (both substances and substance categories) like acetone or alcohols were collected.

- Furthermore information were gathered about;
- type of application of the solvents
  - final application,
  - cleaner,
  - product preparation;
- type of waste gas treatment
  - open application,
  - waste gas collection,
  - waste gas treatment.

For every category of application and waste gas treatment an emission factor was estimated to calculate solvent emissions in the year 2000 (see Table 237).

Table 237: Emission factors for NMVOC emissions from Solvent Use.

Category	Factor
final application	1.00
cleaner	0.85
product preparation	0.05
open application	1.00
waste gas collection	0.50
waste gas treatment	0.20

The above mentioned survey was carried out at all industrial branches with solvent applications, results for solvent use per substance category were collected at NACE-level-4. The total amounts of solvents used per industrial branch were extrapolated using the number of employees (the values of "solvent use per employee" of the sample was multiplied by total employment of the relevant branches taken from national employment statistics (STATISTIK AUSTRIA 2000 & 1998) and using information from (KSV1870 INFORMATION 2000).

For three pillar years (1980, 1990, 1995) the values for solvent use were extrapolated using the factor "solvent use per employee" of the year 2000 and the number of employees of the respective year taken from national statistics (Statistik Austria 2001)(WINDSPERGER et al. 2004). For the pillar year 2005 the structural business statistics (number of employees (NACE Rev.1.1)) were taken from (EUROSTAT 2008).

In a second step a survey in 1 800 households was made (WINDSPERGER et al. 2002a) for estimating the domestic solvent use (37 categories in 5 main groups: cosmetic, do-it-yourself, household cleaning, car, fauna and flora). Also, solvent use in the context of moonlighting besides commercial work and do-it-yourself was calculated.

The comparison of top down and bottom up approach helped to identify several additional applications that make an important contribution to the total amount of solvents used. Thus in a third step the quantities of solvents used in these applications such as windscreens wiper fluids, antifreeze, hospitals, de-icing agents of aeroplanes, tourism, cement- respectively pulp industry, were estimated in surveys.

The outcome of these three steps was the total stock of solvents used for each application in the year 2000 (at SNAP level 3) (WINDSPERGER et al. 2002a). To achieve a time series the development of the economic and technical situation in relation to the year 2000 was considered. It was distinguished between "general aspects" and "specific aspects" (see tables below). The information about these defined aspects were collected for three pillar years (1980, 1990, 1995) and were taken from several studies (SCHMIDT et al. 1998, BARNERT 1998) and expert judgements from associations of industries (chemical industry, printing industry, paper industry) and other stakeholders. On the basis of this information calculation factors were estimated. With these factors and the data for solvent use and emission of 2000 data for the three pillar years was estimated. For the years in between data was linearly interpolated. The 2000 data was also used for the subsequent years as no new survey has been conducted.

Table 238: General aspects and their development.

General aspects	1980	1990	1995	2000	2005
efficiency factor solvent cleaning	250%	150%	130%	100%	100%
efficiency factor application	150%	110%	105%	100%	100%
solvent content of water-based paints	15%	12%	10%	8%	8%
solvent content of solvent-based paints	60%	58%	55%	55%	55%
efficiency of waste gas purification	70%	75%	78%	80%	80%

Table 239: Specific aspects and their development: distribution of the used paints (water based-paints – solvent-based paints) and part of waste gas purification (application – purification).

SNAP category	**description**	**year**	**Distribution of used paints**		**Part of waste gas treatment**	
			Solvent based paints	**Water based paints**	**application**	**purification**
060101	manufacture of automobiles	2005	73%	27%	10%	0%
		2000				
		1995	80%	20%	8%	0%
		1990	90%	10%	5%	0%
		1980	100%	0%	0%	0%
060102	car repairing	2005	51%	49%	62%	1%
		2000				
		1995	55%	45%	60%	0%
		1990	75%	25%	10%	0%
		1980	85%	15%	5%	0%
060107	wood coating	2005	46%	54%	46%	3%
		2000				
		1995	60%	40%	45%	2%
		1990	85%	15%	10%	0%
		1980	100%	0%	0%	0%
060108	Other industrial paint application	2005	97%	3%	90%	46%
		2000				
		1995	99%	1%	87%	45%
		1990	100%	0%	26%	20%
		1980	100%	0%	0%	0%
060201	Metal degreasing	2005	92%	8%	75%	0%
		2000				
		1995	95%	5%	65%	0%
		1990	100%	0%	10%	0%
		1980	100%	0%	0%	0%
060403	Printing industry	2005			44%	17%
		2000				
		1995			29%	10%
		1990			10%	5%
		1980			0%	0%
060405	Application of glues and adhesives	2005			58%	0%
		2000				
		1995			53%	0%
		1990			15%	0%
		1980			0%	0%

SNAP category	description	year	Distribution of used paints		Part of waste gas treatment	
			Solvent based paints	Water based paints	application	purification
060103	Paint application: construction and buildings	2005	91%	9%	19%	4%
		2000				
		1995	93%	7%	15%	2%
		1990	100%	0%	5%	0%
		1980	100%	0%	0%	0%
060105	Paint application : coil coating	2005	100%	0%	63%	0%
		2000				
		1995	100%	0%	60%	0%
		1990	100%	0%	25%	0%
		1980	100%	0%	0%	0%
060406	Preservation of wood	2005	83%	17%	0%	0%
		2000				
		1995	85%	15%	0%	0%
		1990	95%	5%	0%	0%
		1980	100%	0%	0%	0%
060412	Other (preservation of seeds, …)	2005	100%	0%	90%	0%
		2000				
		1995	100%	0%	80%	0%
		1990	100%	0%	10%	0%
		1980	100%	0%	0%	0%

Table 240: Specific aspects and their development: changes in the number of employees compared to the year 2000.

SNAP		Changes in the number of employees compared to the year 2000				
		1980	1990	1995	2000	2005
0601	**Paint application**					
060101	manufacture of automobiles	88%	82%	72%	100%	131%
060102	car repairing	94%	98%	96%	100%	107%
060103	construction and buildings	96%	90%	102%	100%	106%
060104	domestic use	separate analysed				
060105	coil coating	99%	113%	107%	100%	96%
060107	wood coating	107%	109%	112%	100%	90%
060108	industrial paint application	122%	112%	106%	100%	101%
0602	**Degreasing, dry cleaning and electronics**					
060201	Metal degreasing	151%	113%	83%	100%	104%
060202	Dry cleaning	63%	75%	88%	100%	103%
060203	Electronic components manufacturing	143%	122%	104%	100%	84%
060204	Other industrial cleaning	33%	77%	56%	100%	130%

SNAP		Changes in the number of employees compared to the year 2000				
		1980	1990	1995	2000	2005
0603	**Chemical products manufacturing and processing**					
060305	Rubber processing	110%	101%	102%	100%	75%
060306	Pharmaceutical products manufacturing	118%	112%	97%	100%	90%
060307	Paints manufacturing	118%	112%	97%	100%	101%
060308	Inks manufacturing	118%	112%	97%	100%	100%
060309	Glues manufacturing	118%	112%	98%	100%	62%
060310	Asphalt blowing	124%	120%	120%	100%	94%
060311	Adhesive, magnetic tapes, films and photographs	33%	57%	76%	100%	97%
060312	Textile finishing	241%	171%	132%	100%	71%
060314	Other	117%	112%	98%	100%	88%
0604	**Other use of solvents and related activities**					
060403	Printing industry	129%	125%	111%	100%	85%
060404	Fat, edible and non edible oil extraction	129%	116%	112%	100%	52%
060405	Application of glues and adhesives	239%	156%	104%	100%	56%
060406	Preservation of wood	108%	105%	100%	100%	110%
060407	Under seal treatment and conservation of vehicles	97%	102%	103%	100%	101%
060408	Domestic solvent use (other than paint application	separate analysed				
060411	Domestic use of pharmaceutical products (k)					
060412	Other (preservation of seeds, …)	108%	105%	101%	100%	107%

A comprehensive summary on the methodology for the year 2000 can also be found in the Austrian Informative Inventory Report (UMWELTBUNDESAMT 2009).

5.2.4 Combination Top down – Bottom up approach and updating

To verify and adjust the data the solvents given in the top down approach and the results of the bottom up approach were differentiated in the pillar years (1980, 1990, 1995, 2000) by 15 defined categories of solvent groups. For the updated pillar year 2005 only the total difference is shown because no complete bottom up survey was carried out (see below Table 241). The differences between the quantities of solvents from the top down approach and bottom up approach between 1980 and 2000 respectively are lower than 15%. Since 2000 no new bottom up survey has been conducted, therefore the difference has been increased up to 25%. Table 241 shows the range of the differences in the considered pillar years broken down to the 15 substance categories.

Table 241: Differences between the results of the bottom up and the top down approach.

	Acetone	Methanol	Propanol	Solvent naphta	Paraffins	Alcohols	Glycols	Ester	Aromates	Ether	org. acids	Ketones	Aldehydes	Amines	cycl. Hydrocarb.	Others	Sum of Differences [kt/a]
2005	░	░	░	▒	░	░	▒	░	░	░	░	░	▒	░	░	░	-44
2000	░	░	░	▒	░	░	▒	░	░	░	░	░	▒	░	░	░	-
1995	░	░	▒	░	░	░	░	░	░	░	░	░	░	░	▒	░	-7
1990	▒	▒		▒	▒	░	▒	▒	█	░	░	▒	░	░	░	░	8
1980	▒	▒		▒	▒	█	▒	█	░	▒	░	▒	░	░	█	█	-26

░	*difference less than 2 kt/a*
▒	*difference 2–10 kt/a*
█	*difference greater than 10 kt/a*

As the data of the top down approach were obtained from national statistics, they are assumed to be more reliable than the data of the bottom up approach. That's why the annual quantities of solvents used were taken from the top down approach while the share of the solvents for the different applications (on SNAP level 3) and the solvent emission factors have been calculated on the basis of the bottom up approach. Table 242 presents activity data and implied emission factors.

Table 242: Activity data for solvent and other product use [Mg].

NFR	3 A							
SNAP	**Total**	**060101**	**060102**	**060103**	**060104**	**060105**	**060107**	**060108**
Unit	**Mg Solvent**							
1990	54 665	1 785	995	3 827	4 535	5 626	7 002	30 896
1991	48 827	1 515	889	3 542	3 558	5 061	6 139	28124
1992	41 825	1 230	763	3 140	2 627	4 366	5 160	24 540
1993	45 119	1 254	823	3 502	2 382	4 742	5 460	26 956
1994	45 044	1 179	823	3 609	1 929	4 767	5 345	27 392
1995	52 085	1 280	953	4 304	1 714	5 550	6 059	32 226
1996	49 249	1 303	904	4 073	1 666	5 177	5 537	30 589
1997	52 612	1 495	968	4 355	1 830	5 452	5 702	32 809
1998	47 117	1 435	870	3 904	1 686	4 809	4 907	29 505
1999	42 917	1 399	796	3 559	1 581	4 311	4 281	26 991
2000	50 391	1 755	938	4 183	1 911	4 976	4 794	31 834
2001	53 759	1 977	1 008	4 486	2 035	5 232	4 980	34 042
2002	57 849	2 239	1 092	4 852	2 187	5 548	5 215	36 716
2003	59 073	2 398	1 123	4 979	2 229	5 583	5 182	37 579
2004	50 757	2 155	971	4 299	1 913	4 727	4 330	32 361
2005	57 627	2 554	1 110	4 905	2 168	5 289	4 779	36 822
2006	67 838	3 006	1 307	5 774	2 552	6 226	5 626	43 347
2007	61 707	2 734	1 189	5 252	2 322	5 663	5 118	39 430
2008	57 003	2 526	1 098	4 852	2 145	5 232	4 727	36 424
2009	41 522	1 840	800	3 534	1 562	3 811	3 444	26 531
2010	47 860	2 121	922	4 074	1 801	4 392	3 969	30 582
2011	46 857	2 076	902	3 988	1 763	4 300	3 886	29 941

NFR	3 B				
SNAP	**Total**	**060201**	**060202**	**060203**	**060204**
Unit	**Mg Solvent**				
1990	15 926	9 258	459	2 191	4 017
1991	14 001	7 866	408	1 902	3 826
1992	11 803	6 394	348	1 582	3 479
1993	12 527	6 528	373	1 655	3 971
1994	12 302	6 149	370	1 602	4 181
1995	13 990	6 687	426	1 794	5 083
1996	13 989	6 626	417	1 694	5 252
1997	15 792	7 415	461	1 808	6 107
1998	14 933	6 955	428	1 617	5 933
1999	14 353	6 634	404	1 471	5 844
2000	17 773	8 155	492	1 725	7 401
2001	19 308	8 696	524	1 768	8 321
2002	21 146	9 352	562	1 825	9 406
2003	21 964	9 545	573	1 786	10 060
2004	19 187	8 197	492	1 469	9 029
2005	22 136	9 301	558	1 594	10 684
2006	26 059	10 949	656	1 876	12 577
2007	23 704	9 960	597	1 706	11 440
2008	21 897	9 201	552	1 576	10 568
2009	15 950	6 702	402	1 148	7 698
2010	18 385	7 725	463	1 323	8 873
2011	17 999	7 563	453	1 296	8 687

NFR	3 C									
SNAP	**Total**	**060305**	**060306**	**060307**	**060308**	**060309**	**060310**	**060311**	**060312**	**060314**
Unit	**Mg Solvent**									
1990	18 585	977	8 272	3 170	359	829	1 329	3	157	3 488
1991	15 609	853	6 886	2 582	313	743	1 158	3	131	2 940
1992	12 525	714	5 470	1 998	262	639	967	3	105	2 369
1993	12 603	752	5 440	1 926	275	691	1 017	3	104	2 394
1994	11 679	733	4 973	1 695	268	692	989	3	96	2 230
1995	12 465	826	5 223	1 697	302	803	1 114	4	101	2 395
1996	12 305	749	5 614	1 525	282	791	987	4	89	2 265
1997	13 722	764	6 749	1 541	297	879	980	4	87	2 420
1998	12 828	650	6 746	1 298	263	819	809	4	71	2 167
1999	12 196	561	6 812	1 104	236	777	671	4	57	1 974
2000	14 948	619	8 816	1 200	273	949	708	5	59	2 319
2001	15 523	623	9 163	1 256	290	928	742	5	58	2 457
2002	16 253	631	9 604	1 325	310	910	784	6	58	2 626
2003	16 143	604	9 550	1 327	314	839	786	6	55	2 663
2004	13 486	485	7 986	1 118	268	644	664	5	43	2 273
2005	14 880	513	8 822	1 244	302	646	740	5	44	2 563
2006	17 516	604	10 385	1 464	356	760	871	6	52	3 018
2007	15 933	549	9 447	1 332	324	692	792	6	47	2 745
2008	14 719	507	8 727	1 230	299	639	732	5	44	2 536
2009	10 721	370	6 356	896	218	465	533	4	32	1 847

NFR	3 C								
SNAP	**Total**	**060305**	**060306**	**060307**	**060308**	**060309**	**060310**	**060311**	**060312**	**060314**
Unit	**Mg Solvent**									
2010	12 358	426	7 327	1 033	251	536	614	4	37	2 129
2011	12 099	417	7 173	1 011	246	525	602	4	36	2 084

NFR	**3 D 5**								
SNAP	**Total**	**060403**	**060404**	**060405**	**060406**	**060407**	**060408**	**060411**	**060412**
Unit	**Mg Solvent**								
1990	48 748	14 729	510	836	677	217	13 842	4 984	12 952
1991	44 506	13 050	442	717	601	197	13 305	4 578	11 617
1992	38 946	11 089	366	588	512	171	12 200	4 029	9 992
1993	42 897	11 865	382	607	549	186	14 023	4 462	10 823
1994	43 705	11 749	369	579	545	188	14 857	4 569	10 849
1995	51 548	13 474	412	637	627	220	18 167	5 416	12 595
1996	49 960	12 541	369	601	594	203	18 238	5 265	12 149
1997	54 728	13 177	370	640	637	211	20 664	5 784	13 245
1998	50 278	11 594	309	571	572	183	19 608	5 329	12 110
1999	46 998	10 364	261	519	522	162	18 907	4 996	11 267
2000	56 657	11 929	281	607	615	184	23 483	6 040	13 519
2001	59 520	12 268	269	587	666	195	24 647	6 433	14 456
2002	63 067	12 715	256	567	726	209	26 092	6 911	15 591
2003	63 413	12 493	229	515	751	212	26 210	7 046	15 956
2004	53 648	10 319	169	387	654	181	22 153	6 045	13 740
2005	59 970	11 250	161	378	752	204	24 739	6 852	15 634
2006	70 596	13 243	189	445	885	241	29 123	8 066	18 404
2007	64 216	12 047	172	405	805	219	26 491	7 337	16 741
2008	59 321	11 128	159	374	744	202	24 471	6 778	15 464
2009	43 210	8 106	116	273	542	147	17 825	4 937	11 264
2010	49 806	9 343	133	314	624	170	20 546	5 691	12 984
2011	48 762	9 148	131	308	611	166	20 116	5 572	12 712

Table 243: NMVOC emission of Category 3 Solvent and Other Product Use 1990–2011.

NFR	**3 A**	**3 A 2**	**3 A 1**	**3 A 1**	**3 A 1**	**3 A 2**	**3 A 1**	**3 A 2**
SNAP	**Total**	**060101**	**060102**	**060103**	**060104**	**060105**	**060107**	**060108**
Unit	**Mg**							
1990	45 790	1 679	971	3 659	4 012	4 733	6 563	24 173
1991	37 875	1 335	866	3 341	3 149	3 996	5 480	19 709
1992	29 790	1 011	740	2 921	2 327	3 222	4 376	15 194
1993	29 206	956	796	3 211	2 112	3 254	4 386	14 490
1994	26 166	829	793	3 263	1 711	3 025	4 056	12 488
1995	26 720	825	916	3 834	1 521	3 235	4 327	12 062
1996	24 663	821	856	3 619	1 479	2 962	3 907	11 018
1997	25 702	921	905	3 859	1 625	3 062	3 975	11 355
1998	22 437	864	802	3 450	1 497	2 649	3 379	9 796
1999	19 905	822	722	3 137	1 403	2 329	2 911	8 581
2000	22 745	1 006	839	3 676	1 696	2 635	3 220	9 672
2001	24 083	1 141	899	3 949	1 807	2 759	3 344	10 184
2002	25 720	1 300	971	4 279	1 941	2 914	3 501	10 813

NFR	3 A	3 A 2	3 A 1	3 A 1	3 A 1	3 A 2	3 A 1	3 A 2
SNAP	Total	060101	060102	060103	060104	060105	060107	060108
Unit	Mg							
2003	26 066	1 401	995	4 399	1 979	2 921	3 478	10 892
2004	22 226	1 267	858	3 805	1 698	2 463	2 905	9 229
2005	25 042	1 510	978	4 349	1 925	2 745	3 206	10 330
2006	29 480	1 778	1 151	5 119	2 266	3 231	3 774	12 161
2007	26 816	1 617	1 047	4 657	2 061	2 939	3 433	11 062
2008	24 771	1 494	967	4 302	1 904	2 715	3 171	10 218
2009	18 044	1 088	704	3 133	1 387	1 978	2 310	7 443
2010	20 798	1 254	812	3 612	1 598	2 280	2 663	8 579
2011	20 362	1 228	795	3 536	1 565	2 232	2 607	8 400

NFR	3 B	3 B 1	3 B 2	3 B 1	3 B 1
SNAP	Total	060201	060202	060203	060204
Unit	Mg				
1990	13 699	8 655	436	1 704	2 903
1991	11 262	6 764	382	1 371	2 745
1992	8 869	5 019	321	1 050	2 479
1993	8 788	4 634	339	1 005	2 810
1994	8 055	3 905	331	882	2 937
1995	8 551	3 745	375	886	3 545
1996	8 387	3 560	365	818	3 644
1997	9 285	3 816	401	853	4 215
1998	8 610	3 422	369	745	4 073
1999	8 112	3 113	346	662	3 991
2000	9 846	3 643	418	757	5 028
2001	10 694	3 847	444	754	5 648
2002	11 709	4 099	477	757	6 377
2003	12 161	4 143	485	720	6 813
2004	10 623	3 523	416	574	6 109
2005	12 255	3 959	471	604	7 221
2006	14 426	4 661	554	711	8 500
2007	13 122	4 239	504	647	7 732
2008	12 122	3 916	466	598	7 143
2009	8 830	2 853	339	435	5 203
2010	10 178	3 288	391	502	5 997
2011	9 964	3 219	383	491	5 871

NFR	3 C	3 C	3 C	3 C	3 C	3 C	3 C	3 C	3 C	3 C
SNAP	Total	060305	060306	060307	060308	060309	060310	060311	060312	060314
Unit	Mg									
1990	12 790	963	3 826	3 170	359	829	13	3	139	3 488
1991	10 441	837	2 896	2 582	313	743	12	3	116	2 940
1992	8 140	697	2 071	1 998	262	639	10	2	92	2 369
1993	7 955	731	1 832	1 926	275	691	10	3	92	2 394
1994	7 158	709	1 466	1 695	268	692	10	3	85	2 230
1995	7 418	796	1 321	1 697	302	803	11	3	89	2 395
1996	7 097	718	1 425	1 525	282	791	10	3	78	2 265

NFR	3 C	3 C	3 C	3 C	3 C	3 C	3 C	3 C	3 C	3 C
SNAP	**Total**	**060305**	**060306**	**060307**	**060308**	**060309**	**060310**	**060311**	**060312**	**060314**
Unit					**Mg**					
1997	7 676	728	1 720	1 541	297	879	10	4	77	2 420
1998	6 964	616	1 726	1 298	263	819	8	4	62	2 167
1999	6 430	528	1 750	1 104	236	777	7	4	51	1 974
2000	7 659	579	2 274	1 200	273	949	7	5	52	2 319
2001	7 942	582	2 365	1 256	290	928	7	5	52	2 457
2002	8 305	589	2 481	1 325	310	910	8	5	51	2 626
2003	8 237	563	2 469	1 327	314	839	8	5	48	2 663
2004	6 870	452	2 067	1 118	268	644	7	4	38	2 273
2005	7 569	477	2 285	1 244	302	646	7	5	39	2 563
2006	8 910	562	2 689	1 464	356	760	9	6	46	3 018
2007	8 105	511	2 446	1 332	324	692	8	5	42	2 745
2008	7 487	472	2 260	1 230	299	639	7	5	39	2 536
2009	5 453	344	1 646	896	218	465	5	4	28	1 847
2010	6 286	396	1 897	1 033	251	536	6	4	32	2 129
2011	6 154	388	1 858	1 011	246	525	6	4	32	2 084

NFR	3 D	3 D 1	3 D 4	3 D 4	3 D 2	3 D 4	3 D 3	3 D 3	3 D 4
SNAP	**Total**	**060403**	**060404**	**060405**	**060406**	**060407**	**060408**	**060411**	**060412**
Unit					**Mg**				
1990	42 154	12 654	102	719	671	185	11 607	4 689	11 527
1991	37 353	10 763	89	592	596	167	11 162	4 307	9 677
1992	31 741	8 765	74	466	507	145	10 239	3 791	7 754
1993	33 966	8 972	77	460	544	158	11 774	4 198	7 782
1994	33 636	8 481	74	419	540	160	12 480	4 299	7 183
1995	38 579	9 264	83	440	621	187	15 267	5 096	7 621
1996	37 323	8 546	74	409	589	172	15 332	4 953	7 247
1997	40 819	8 899	74	429	631	179	17 377	5 442	7 787
1998	37 446	7 760	62	377	567	156	16 494	5 014	7 017
1999	34 959	6 874	52	337	518	138	15 908	4 701	6 431
2000	42 098	7 839	56	388	610	156	19 765	5 683	7 601
2001	44 182	8 047	54	374	660	166	20 743	6 053	8 086
2002	46 769	8 324	52	360	720	177	21 956	6 503	8 677
2003	46 979	8 165	46	326	745	180	22 054	6 630	8 834
2004	39 705	6 731	34	244	649	154	18 638	5 687	7 568
2005	44 339	7 325	32	238	746	174	20 812	6 447	8 566
2006	52 195	8 623	38	280	878	205	24 500	7 589	10 084
2007	47 478	7 843	35	255	798	186	22 286	6 903	9 172
2008	43 859	7 245	32	235	738	172	20 587	6 377	8 473
2009	31 947	5 278	23	171	537	125	14 995	4 645	6 172
2010	36 824	6 083	27	197	619	144	17 285	5 354	7 114
2011	36 052	5 956	26	193	606	141	16 922	5 242	6 965

Table 244: Implied NMVOC Emission factors for Category 3 Solvent and Other Product Use 1990–2011.

NFR	**3 A**	**3 A 2**	**3 A 1**	**3 A 1**	**3 A 1**	**3 A 2**	**3 A 1**
SNAP	**060101**	**060102**	**060103**	**060104**	**060105**	**060107**	**060108**
Unit	**[gNMVOC/t]**						
1990	940 256	976 330	956 090	884 692	841 282	937 303	782 407
1991	881 087	973 302	943 066	885 292	789 602	892 671	700 783
1992	821 917	970 273	930 042	885 892	737 923	848 039	619 160
1993	762 747	967 245	917 018	886 492	686 243	803 408	537 536
1994	703 578	964 216	903 994	887 092	634 563	758 776	455 913
1995	644 408	961 188	890 970	887 692	582 884	714 144	374 290
1996	630 223	947 902	888 550	887 692	572 205	705 644	360 196
1997	616 038	934 617	886 130	887 692	561 525	697 144	346 102
1998	601 854	921 331	883 710	887 692	550 846	688 645	332 009
1999	587 669	908 045	881 290	887 692	540 167	680 145	317 915
2000	573 484	894 760	878 870	887 692	529 488	671 645	303 822
2001	577 070	891 965	880 412	887 692	527 394	671 485	299 166
2002	580 657	889 170	881 954	887 692	525 300	671 325	294 510
2003	584 243	886 375	883 496	887 692	523 207	671 166	289 854
2004	587 829	883 580	885 038	887 692	521 113	671 006	285 198
2005	591 416	880 785	886 579	887 692	519 020	670 846	280 542
2006	591 416	880 785	886 579	887 692	519 020	670 846	280 542
2007	591 416	880 785	886 579	887 692	519 020	670 846	280 542
2008	591 416	880 785	886 579	887 692	519 020	670 846	280 542
2009	591 416	880 785	886 579	887 692	519 020	670 846	280 542
2010	591 416	880 785	886 579	887 692	519 020	670 846	280 542
2011	591 416	880 785	886 579	887 692	519 020	670 846	280 542

NFR	**3 B 1**	**3 B 2**	**3 B 1**	**3 B 1**
SNAP	**060201**	**060202**	**060203**	**060204**
Unit	**[gNMVOC/t]**			
1990	934 873	950 000	777 577	722 712
1991	859 909	936 000	720 859	717 653
1992	784 944	922 000	664 140	712 594
1993	709 980	908 000	607 421	707 534
1994	635 015	894 000	550 703	702 475
1995	560 051	880 000	493 984	697 416
1996	537 371	874 000	482 891	693 820
1997	514 691	868 000	471 797	690 225
1998	492 011	862 000	460 703	686 629
1999	469 331	856 000	449 609	683 033
2000	446 651	850 000	438 516	679 438
2001	442 449	848 808	426 636	678 723
2002	438 247	847 617	414 757	678 007
2003	434 045	846 425	402 878	677 292
2004	429 844	845 234	390 999	676 577
2005	425 642	844 042	379 120	675 861
2006	425 642	844 042	379 120	675 861
2007	425 642	844 042	379 120	675 861

NFR	**3 B 1**	**3 B 2**	**3 B 1**	**3 B 1**
SNAP	**060201**	**060202**	**060203**	**060204**
Unit	**[gNMVOC/t]**			
2008	425 642	844 042	379 120	675 861
2009	425 642	844 042	379 120	675 861
2010	425 642	844 042	379 120	675 861
2011	425 642	844 042	379 120	675 861

NFR	**3 C**	**3 C**	**3 C**	**3 C**	**3 C**	**3 C**	**3 C**	**3 C**	**3 C**
SNAP	**060305**	**060306**	**060307**	**060308**	**060309**	**060310**	**060311**	**060312**	**060314**
Unit	**[gMNVOC/t]**								
1990	985 593	462 467	1 000 000	1 000 000	1 000 000	10 017	914 940	882 325	1 000 000
1991	981 271	420 541	1 000 000	1 000 000	1 000 000	10 017	915 713	882 325	1 000 000
1992	976 950	378 615	1 000 000	1 000 000	1 000 000	10 017	916 486	882 325	1 000 000
1993	972 628	336 689	1 000 000	1 000 000	1 000 000	10 017	917 260	882 325	1 000 000
1994	968 306	294 763	1 000 000	1 000 000	1 000 000	10 017	918 033	882 325	1 000 000
1995	963 984	252 837	1 000 000	1 000 000	1 000 000	10 017	918 806	882 325	1 000 000
1996	958 317	253 856	1 000 000	1 000 000	1 000 000	10 017	922 804	882 325	1 000 000
1997	952 651	254 876	1 000 000	1 000 000	1 000 000	10 017	926 802	882 325	1 000 000
1998	946 984	255 896	1 000 000	1 000 000	1 000 000	10 017	930 800	882 325	1 000 000
1999	941 318	256 915	1 000 000	1 000 000	1 000 000	10 017	934 798	882 325	1 000 000
2000	935 652	257 935	1 000 000	1 000 000	1 000 000	10 017	938 796	882 325	1 000 000
2001	934 525	258 140	1 000 000	1 000 000	1 000 000	10 021	939 598	882 737	1 000 000
2002	933 399	258 345	1 000 000	1 000 000	1 000 000	10 024	940 401	883 148	1 000 000
2003	932 272	258 549	1 000 000	1 000 000	1 000 000	10 028	941 204	883 560	1 000 000
2004	931 146	258 754	1 000 000	1 000 000	1 000 000	10 031	942 007	883 972	1 000 000
2005	930 019	258 959	1 000 000	1 000 000	1 000 000	10 035	942 810	884 383	1 000 000
2006	930 019	258 959	1 000 000	1 000 000	1 000 000	10 035	942 810	884 383	1 000 000
2007	930 019	258 959	1 000 000	1 000 000	1 000 000	10 035	942 810	884 383	1 000 000
2008	930 019	258 959	1 000 000	1 000 000	1 000 000	10 035	942 810	884 383	1 000 000
2009	930 019	258 959	1 000 000	1 000 000	1 000 000	10 035	942 810	884 383	1 000 000
2010	930 019	258 959	1 000 000	1 000 000	1 000 000	10 035	942 810	884 383	1 000 000
2011	930 019	258 959	1 000 000	1 000 000	1 000 000	10 035	942 810	884 383	1 000 000

NFR	**3 D 1**	**3 D 4**	**3 D 4**	**3 D 2**	**3 D 4**	**3 D 3**	**3 D 3**	**3 D 4**
SNAP	**060403**	**060404**	**060405**	**060406**	**060407**	**060408**	**060411**	**060412**
Unit	**[gMNVOC/t]**							
1990	859 068	200 885	859 961	990 475	850 000	838 540	940 864	890 009
1991	824 765	200 885	826 067	990 536	850 000	838 915	940 864	833 022
1992	790 462	200 885	792 173	990 598	850 000	839 290	940 864	776 036
1993	756 159	200 885	758 279	990 660	850 000	839 665	940 864	719 049
1994	721 856	200 885	724 386	990 722	850 000	840 040	940 864	662 063
1995	687 553	200 885	690 492	990 784	850 000	840 415	940 864	605 076
1996	681 467	200 885	680 134	990 951	850 000	840 668	940 864	596 510
1997	675 380	200 885	669 776	991 117	850 000	840 921	940 864	587 943
1998	669 293	200 885	659 418	991 284	850 000	841 174	940 864	579 376
1999	663 207	200 885	649 060	991 451	850 000	841 427	940 864	570 809
2000	657 120	200 885	638 702	991 618	850 000	841 680	940 864	562 242

NFR	**3 D 1**	**3 D 4**	**3 D 4**	**3 D 2**	**3 D 4**	**3 D 3**	**3 D 3**	**3 D 4**
SNAP	**060403**	**060404**	**060405**	**060406**	**060407**	**060408**	**060411**	**060412**
Unit	**[gMNVOC/t]**							
2001	655 914	200 885	636 663	991 652	850 000	841 596	940 864	559 374
2002	654 708	200 885	634 625	991 685	850 000	841 512	940 864	556 506
2003	653 502	200 885	632 586	991 718	850 000	841 428	940 864	553 639
2004	652 296	200 885	630 548	991 752	850 000	841 344	940 864	550 771
2005	651 090	200 885	628 509	991 785	850 000	841 260	940 864	547 903
2006	651 090	200 885	628 509	991 785	850 000	841 260	940 864	547 903
2007	651 090	200 885	628 509	991 785	850 000	841 260	940 864	547 903
2008	651 090	200 885	628 509	991 785	850 000	841 260	940 864	547 903
2009	651 090	200 885	628 509	991 785	850 000	841 260	940 864	547 903
2010	651 090	200 885	628 509	991 785	850 000	841 260	940 864	547 903
2011	651 090	200 885	628 509	991 785	850 000	841 260	940 864	547 903

5.3 Recalculation for Emissions from Solvent and Other Product Use

There were no recalculations for NMVOC.

5.4 Emissions of Particulate Matter (PM) from Other product use (Category 3 D 3)

The category 3 D 3 covers emissions which originate from the use of fireworks and tobacco.

	3 D 3 Use of fireworks (SNAP 0604)	3 D 3 Use of tobacco (SNAP 0604)
key category	no	no
pollutant	TSP, PM10, PM2.5	
activity	Inhabitants	
method	A country specific methodology is applied.[144] Emission$_{(TSP,\ PM10,\ PM2,5)}$ = activity * emission factor$_{(TSP,\ PM10,\ PM2,5)}$	
emission factor	35 g PM2,5 / inhabitants (TSP = PM10 = PM2,5)	18 g PM2,5 / inhabitants (TSP = PM10 = PM2,5)
recalculation	no recalculation	

Table 245: PM10 emission of Category 3 Solvent and Other Product Use 1990–2011.

NFR	PM10 emission of	
	3 D 3 Use of fireworks	3 D 3 Use of tobacco
SNAP	**0604**	**060404**
Unit	**Mg**	**Mg**
1990	268.72	138.20
1991	271.42	139.59
1992	274.42	141.13
1993	276.70	142.30
1994	277.76	142.85
1995	278.19	143.07
1996	278.57	143.26
1997	278.88	143.42
1998	279.19	143.58
1999	279.73	143.86
2000	280.40	144.21
2001	281.48	144.76
2002	282.87	145.48
2003	284.14	146.13
2004	285.93	147.05
2005	287.88	148.06
2006	289.38	148.82
2007	290.53	149.42
2008	291.78	150.06
2009	292.71	150.53
2010	293.57	150.98
2011	294.73	151.58

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[144] Winiwarter, W.; Schmidt-Stejskal, H.& Windsperger, A. (2007): Aktualisierung und methodische Verbesserung der österreichischen Luftschadstoffinventur für Schwebstaub Endbericht. Dezember 2007. ARC—sys-0149.

6 AGRICULTURE (NFR SECTOR 4)

6.1 Sector Overview

This chapter includes information on the estimation of the emissions of NEC gases, CO, particle matter (PM), heavy metals (HM) and persistent organic pollutant (POP) of the sector *Agriculture* in Austria corresponding to the data reported in Category 4 of the NFR format. It describes the calculations of source categories *4 B Manure Management, 4 D Agricultural Soils, 4 F Field Burning of Agricultural Residues* and *4 G Other.*

For the other pollutants the agricultural sector is only a minor source: emissions of SO_2, CO, heavy metals and POPs exclusively PAH arise from category *4 F Field Burning of Agricultural Wastes*; the contribution to the national total for SO_2, CO, dioxin, HCBs and heavy metals was below 0.3% for the whole time series.

To give an overview of Austria's agricultural sector some information is provided below (according to the 2010 Farm Structure Survey – full survey) (BMLFUW 2000–2012): Agriculture in Austria is small-structured: 173 317 farms are managed, 56.3% of these farms manage less than 20 ha, whereas only 4.2% of the Austrian farms manage more than 100 ha cultivated area. 129 117 holdings are classified as situated in less favoured areas. Related to the federal territory Austria has the highest share of mountainous areas in the EU (70%).

The agricultural area comprises 2.88 million hectares that is a share of ~ 39% of the total territory (forestry ~ 46%, other area ~ 14%). The shares of the different agricultural activities are as follows:

- 48% arable land,
- 20% grassland (meadows mown several times and seeded grassland),
- 30% extensive grassland (meadows mown once, litter meadows, rough pastures, Alpine pastures and mountain meadows),
- 2% other types of agricultural land-use (vineyards, orchards, house gardens, vine and tree nurseries).

6.2 NFR 4 B Manure Management

In submission 2010 new representative data on animal husbandry and manure management systems all over Austria were implemented. Data are based on the research project "Animal husbandry and manure management systems in Austria" (AMON et al. 2007). The inventory revision led to a considerable improvement of the inventory quality (AMON & HÖRTENHUBER 2008 and AMON & HÖRTENHUBER 2010).

6.2.1 Methodological Issues

NH_3 emissions from Sector 4 Agriculture are estimated according to the EMEP/CORINAIR atmospheric emission inventory guidebook (EEA 2007). Emissions from cattle and swine are estimated using a country specific methodology which requires detailed information on animal characteristics and the manner in which manure is managed. Due to a lack in data availability and as they contribute to a minor extent to total emissions, emission from sheep, goats, horses, laying hens, broilers or other poultry are estimated with the CORINAIR simple methodology.

NO_x emissions from manure management have been estimated using the default Tier 1 emission factors of the new EMEP/CORINAIR emission inventory guidebook 2009 (EEA 2009).

Animal numbers

The Austrian official statistics (STATISTIK AUSTRIA 2012b) provides national data of annual livestock numbers on a very detailed level. These data are based on livestock counts held in December each year[145].

In Table 246 and Table 247 applied animal data are presented. Background information to the data is listed below:

From 1990 onwards: The continuous decline of dairy cattle numbers is connected with the increasing milk yield per cow: For the production of milk according to Austria's milk quota every year a smaller number of cows is needed.

1991: A minimum counting threshold for poultry was introduced. Farms with less than 11 poultry were not considered any more. However, the contribution of these small farms is negligible, both with respect to the total poultry number and to the trend.
The increase of the soliped population between 1990 and 1991 is caused by a better data collection from riding clubs and horse breeding farms.

1993: New characteristics for swine and cattle categories were introduced in accordance with Austria's entry into the European Economic Area and the EU guidelines for farm animal population categories. In 1993 part of the "Young cattle < 1 yr" category was included in the "Young cattle 1–2 yr" category. This shift is considered to be insignificant: no inconsistency in the emission trend of "Non-Dairy Cattle" category was recorded.
In the same year "Young swine < 50 kg" were shifted to "Fattening pigs > 50 kg" (before 1993 the limits were 6 months and not 50 kg which led to the shift) causing distinct inconsistencies in time series. Following a recommendation of the Centralized Review 2003, the age class split for swine categories of the years 1990–1992 was adjusted using the split from 1993.

1993: For the first time other animals e.g. deer (but not wild living animals) were counted. Following the recommendations of the Centralized Review 2004, to ensure consistency and completeness animal number of 1993 was used for the years 1990 to 1992.

1995: The financial support of suckling cow husbandry increased significantly in 1995 when Austria became a Member State of the European Union. The husbandry of suckling cows is used for the production of veal and beef; the milk yield of the cow is only provided for the suckling calves. Especially in mountainous regions with unfavourable farming conditions, suckling cow husbandry allows an extensive and economic reasonable utilisation of the pastures. Suckling cow husbandry contributes to the conservation of the traditional Austrian alpine landscape.

1996–1998: The market situation affected a decrease in veal and beef production, resulting in a declining suckling cow husbandry. Farmers partly used their former suckling cows for milk production. Thus, dairy cow numbers slightly increased at this time. Reasons are manifold: Changing market prices, BSE epidemic in Europe and change of consumer behaviour, milk quota etc.

1998–2000; 2006–2008: increasing/ decreasing swine numbers: The production of swine has a high elasticity to prices: Swine numbers are changing due to changing market prices very rapidly. Market prices change due to changes in costumer behaviour, saturation of swine production, epidemics etc.

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[145] For cattle livestock counts are also held in June, but seasonal changes are very small (between 0% and 2%). Livestock counts of sheep are only held in December (sheep is only a minor source for Austria and seasonal changes of the population are not considered relevant).

Table 246: Domestic livestock population and its trend 1990–2011 (I).

Year	Livestock category – Population size [heads] *						
	Dairy	Non-Dairy	Suckling Cows	Young Cattle < 1 yr	Breeding Heifers 1–2 yr	Fattening Heifers, Bulls, Oxen 1–2 yr	Other Cattle > 2 yr
1990	904 617	1 679 297	47 020	925 162	255 464	305 339	146 312
1991	876 000	1 658 088	57 333	894 111	253 522	301 910	151 212
1992	841 716	1 559 009	60 481	831 612	239 569	281 509	145 838
1993	828 147	1 505 740	69 316	705 547	257 939	314 982	157 956
1994	809 977	1 518 541	89 999	706 579	263 591	309 586	148 786
1995	706 494	1 619 331	210 479	691 454	266 108	298 244	153 046
1996	697 521	1 574 428	212 700	670 423	259 747	277 635	153 923
1997	720 377	1 477 563	170 540	630 853	259 494	254 986	161 690
1998	728 718	1 442 963	154 276	635 113	254 251	241 908	157 415
1999	697 903	1 454 908	176 680	630 586	255 244	233 039	159 359
2000	621 002	1 534 445	252 792	655 368	246 382	220 102	159 801
2001	597 981	1 520 473	257 734	658 930	241 556	214 156	148 097
2002	588 971	1 477 971	244 954	640 060	236 706	213 226	143 025
2003	557 877	1 494 156	243 103	641 640	229 150	216 971	163 292
2004	537 953	1 513 038	261 528	646 946	230 943	210 454	163 167
2005	534 417	1 476 263	270 465	628 426	229 874	206 429	141 069
2006	527 421	1 475 498	271 314	631 529	222 104	212 887	137 664
2007	524 500	1 475 696	271 327	634 089	211 044	226 014	133 222
2008	530 230	1 466 979	266 452	636 469	200 787	230 457	132 814
2009	532 976	1 493 284	264 547	643 441	196 476	249 486	139 334
2010	532 735	1 480 546	260 883	634 052	187 386	256 266	141 959
2011	527 393	1 449 134	256 831	623 364	184 160	245 770	139 009
Trend 1990–2011	*-41.7%*	*-13.7%*	*446.2%*	*-32.6%*	*-27.9%*	*-19.5%*	*-5.0%*

* *adjusted age class split for swine as recommended in the UNFCCC centralized review (October 2003)*

The FAO agricultural data base (FAOSTAT) provides worldwide harmonized data (FAO AGR. STATISTICAL SYSTEM 2001). In the case of Austria, these data come from the national statistical system (Statistik Austria). However, there are inconsistencies between these two data sets. Analysis shows that there is often a time gap of one year between the two data sets. FAOSTAT data are seemingly based on the official Statistik Austria data but there is an annual attribution error. In the Austrian inventory Statistik Austria data is used, they are the best available.

Table 247: Domestic livestock population and its trend 1990–2011 (II).

Year	Livestock category - Population size [heads] *					
	Swine	Young & Fattening Pigs > 20 kg	Breeding Sows > 50 kg	Young Swine < 20 kg	Sheep	Goats
1990	3 687 981	2 347 001	382 335	958 645	309 912	37 343
1991	3 637 980	2 315 181	377 152	945 648	326 100	40 923

Year	**Livestock category - Population size [heads] ***					
	Swine	**Young & Fattening Pigs > 20 kg**	**Breeding Sows > 50 kg**	**Young Swine < 20 kg**	**Sheep**	**Goats**
1992	3 719 600	2 367 123	385 613	966 864	312 000	39 400
1993	3 819 798	2 425 852	396 001	997 945	333 835	47 276
1994	3 728 991	2 368 061	394 938	965 992	342 144	49 749
1995	3 706 185	2 356 988	401 490	947 707	365 250	54 228
1996	3 663 747	2 311 988	398 633	953 126	380 861	54 471
1997	3 679 876	2 330 334	397 742	951 800	383 655	58 340
1998	3 810 310	2 456 935	386 281	967 094	360 812	54 244
1999	3 433 029	2 226 307	343 812	862 910	352 277	57 993
2000	3 347 931	2 160 338	334 278	853 315	339 238	56 105
2001	3 440 405	2 220 765	350 197	869 443	320 467	59 452
2002	3 304 650	2 146 968	341 042	816 640	304 364	57 842
2003	3 244 866	2 125 371	334 329	785 166	325 495	54 607
2004	3 125 361	2 016 005	317 033	792 323	327 163	55 523
2005	3 169 541	2 091 225	315 731	762 585	325 728	55 100
2006	3 139 438	2 038 170	321 828	779 440	312 375	53 108
2007	3 286 292	2 171 519	318 349	796 424	351 329	60 487
2008	3 064 231	2 023 536	297 830	742 865	333 181	62 490
2009	3 136 967	2 083 459	293 901	759 607	344 709	68 188
2010	3 134 156	2 084 923	284 691	764 542	358 415	71 768
2011	3 004 907	2 011 138	275 874	717 895	361 183	72 358
Trend 1990–2011	*-18.5%*	*-14.3%*	*-27.8%*	*-25.1%*	*16.5%*	*93.8%*

** from 1990 to 1992 adjusted age class split for swine as recommended in the UNFCCC centralized review (October 2003)*

Table 248: Domestic livestock population and its trend 1990–2011 (III).

Year	**Livestock category - Population size [heads] ***				
	Poultry	**Chicken**	**Other Poultry**	**Horses**	**Other**
1990	13 820 961	13 139 151	681 810	49 200	37 100
1991	14 397 143	13 478 820	918 323	57 803	37 100
1992	13 683 900	12 872 100	811 800	61 400	37 100
1993	14 508 473	13 588 850	919 623	64 924	37 100
1994	14 178 834	13 265 572	913 262	66 748	37 736
1995	13 959 316	13 157 078	802 238	72 491	40 323
1996	12 979 954	12 215 194	764 760	73 234	41 526
1997	14 760 355	13 949 648	810 707	74 170	56 244
1998	14 306 846	13 539 693	767 153	75 347	50 365
1999	14 498 170	13 797 829	700 341	81 566	39 086
2000	11 786 670	11 077 343	709 327	81 566	38 475
2001	12 571 528	11 905 111	666 417	81 566	38 475
2002	12 571 528	11 905 111	666 417	81 566	38 475

Year	Livestock category - Population size [heads] *				
	Poultry	Chicken	Other Poultry	Horses	Other
2003	13 027 145	12 354 358	672 787	87 072	41 190
2004	13 027 145	12 354 358	672 787	87 072	41 190
2005	13 027 145	12 354 358	672 787	87 072	41 190
2006	13 027 145	12 354 358	672 787	87 072	41 190
2007	13 027 145	12 354 358	672 787	87 072	41 190
2008	13 027 145	12 354 358	672 787	87 072	41 190
2009	13 027 145	12 354 358	672 787	87 072	41 190
2010	14 644 413	13 918 813	725 600	81 637	47 575
2011	14 644 413	13 918 813	725 600	81 637	47 575
Trend 1990–2011	*6.0%*	*5.9%*	*6.4%*	*65.9%*	*28.2%*

* *adjusted age class split for swine as recommended in the UNFCCC centralized review (October 2003)*

6.2.2 NH_3 emissions from cattle (4 B 1) and swine (4 B 8)

Key Sources: NH_3

6.2.2.1 Country specific data on agriculture practice

Animal Waste Management System Distribution (AWMS)

In Austria, the distribution of housing and storage systems has undergone major changes. Hence, the Umweltbundesamt commissioned the University of Natural Resources and Applied Life Sciences with the revision of the national emission model of the sector agriculture (AMON & HÖRTENHUBER 2008, AMON & HÖRTENHUBER 2010).

The new input-data on AWMS was taken from the research project 'Animal husbandry and manure management systems in Austria (TIHALO)' (AMON et al. 2007). In this project a comprehensive survey on the agricultural practices in Austria has been carried out. Within this project, the Division of Agricultural Engineering (DAE) of the Department for Sustainable Agricultural Systems of the University of Natural Resources and Applied Life Sciences (BOKU) closely co-operated with the Swiss College of Agriculture, the Austrian Chamber of Agriculture, the Umweltbundesamt, the Agricultural Research and Education Centre Raumberg-Gumpenstein and the Statistics Austria. Firstly, a questionnaire was developed to assess animal housing, manure storage and manure application on typical Austrian farms. In November 2005, the questionnaire was sent to 5 000 Austrian farms. With the active assistance of the regional chambers of agriculture, a rate of questionnaire return of 39% was achieved. The statistical sampling plan was set up with the assistance of the Statistics Austria to guarantee the selection of a representative sample of Austrian farms.

As a result of TIHALO, for 2005 new representative data on animal husbandry and manure management systems all over Austria is available. For the year 1990 AWMS data based on (KONRAD 1995) is available. In this study data on existing Austrian conditions were derived from a research survey carried out on 720 randomly-chosen agricultural enterprises in the years 1989–1992.

For the creation of a plausible time series the AWMS distribution of 1990 (based on KONRAD 1995) partly had to be adopted. Changes to the year 1990 were derived from the new study results (AMON et al. 2007) and expert opinion carried out by DI Alfred Pöllinger (Agricultural Research and Education Centre Raumberg-Gumpenstein) in June 2008. The AWMS data from 2005-2008 were derived by linear extrapolation. From 2008 onwards the AWMS distribution is held constant in order to prevent implausible trends.

The new AWMS data reflect the situation in Austria much better than the distribution from the study by (KONRAD 1995) used before.

Table 249: Share of N in animal waste management systems 1990.

Cattle category	Animal Waste Management Systems 1990					
	Buildings - tied systems		Buildings - loose housing systems		Excreted outside the buildings	
	liquid slurry [%]	solid manure [%]	liquid slurry [%]	solid manure [%]	yards [%]	pasture [%]
Dairy cows	23.6	50.4	11.0	3.4	0.9	10.7
Suckling cows	12.3	58.7	6.0	11.3	1.1	10.7
Cattle < 1 year	11.3	53.3	6.8	23.0	0.8	4.8
Breeding heifers 1–2 years	17.5	39.5	9.4	6.7	0.8	26.2
Fattening heifers, bulls & oxen, 1–2 years	30.4	37.3	18.2	12.8	0.8	0.6
(other) cattle > 2 years	20.6	44.9	9.2	6.6	1.0	17.8
Breeding sows plus litter	--	--	69.2	29.7	1.2	--
Fattening pigs	--	--	71.3	28.2	0.6	--

For yards the values for the year 1990 were estimated to be the half of the values from 2005 (PÖLLINGER 2008).

Table 250: Share of N in animal waste management systems 2005.

Cattle category	Animal Waste Management Systems 2005					
	Buildings - tied systems		Buildings - loose housing systems		Excreted outside the buildings	
	liquid slurry [%]	solid manure [%]	liquid slurry [%]	solid manure [%]	yards [%]	pasture [%]
Dairy cows	13.4	49.9	23.4	7.3	1.8	4.2
Suckling cows	6.1	45.1	11.4	21.6	2.1	13.7
Cattle < 1 year	4.6	30.8	13.8	46.8	1.6	2.4
Breeding heifers 1–2 years	9.9	40.1	22.9	16.4	1.5	9.2
Fattening heifers, bulls & oxen, 1–2 years	12.2	24.4	36.1	25.5	1.5	0.3
(other) cattle > 2 years	12.5	42.0	20.2	14.5	1.9	8.9
Breeding sows plus litter	--	--	60.0	37.7	2.3	--
Fattening pigs	--	--	88.2	10.7	1.1	--

Table 251: Share of N in animal waste management systems 2011.

Cattle category	Animal Waste Management Systems 2011					
	Buildings - tied systems		Buildings - loose housing systems		Excreted outside the buildings	
	liquid slurry [%]	solid manure [%]	liquid slurry [%]	solid manure [%]	yards [%]	pasture [%]
Dairy cows	11.3	49.8	25.9	8.1	2.0	2.9
Suckling cows	4.8	42.4	12.4	23.7	2.3	14.3
Cattle < 1 year	3.3	26.3	15.2	51.5	1.8	1.9
Breeding heifers 1–2 years	8.4	40.2	25.6	18.4	1.7	5.8
Fattening heifers, bulls & oxen, 1–2 years	8.5	21.8	39.7	28.1	1.7	0.2
(other) cattle > 2 years	10.9	41.4	22.5	16.0	2.1	7.1
Breeding sows plus litter	--	--	58.1	39.3	2.5	--
Fattening pigs	--	--	91.6	7.2	1.2	--

Trends in manure management of cattle

The time series shows that tied systems and systems with straw-litter decrease, but still account for the biggest part, whereas loose housing systems and slurry-based systems increase. Small farms use predominantly tied systems, especially with solid manure, while large farms take more use of loose housing systems in general and tied systems with liquid slurry.

While the share of pasture increases for suckling cows, it decreases for other cattle categories.

Trends in manure management of swine

The time series shows that houses with straw-litter for young and fattening pigs decrease, those with slatted floors increase. Houses with straw-litter for breeding sows plus litter seem to have increased during the period. The reason for this may be lie in the approximate and conservative estimate by expert Alfred Pöllinger (in November 2006) following Konrad's (1995) high values between 75 and nearly 100 percent sows on solid manure (with straw) for diverse houses of breeding sows plus litter. Small farms more frequently use systems with solid manure, large farms make more use of slurry systems.

Free range systems for pigs are uncommon in Austria. Data collected within (AMON et al. 2007) showed that hardly any pig had free access to a pasture.

Manure storage – cattle and swine

Table 252 describes the share of composted and not composted solid manure for the years 1990, 2005 and 2011. The values for 2005 are taken from the TIHALO survey (AMON et al. 2007). Those for 1990 were estimated by Alfred Pöllinger in June 2008 on the basis of TIHALO results. The data from 2005-2008 were derived by linear extrapolation and from 2008 onwards the share of composted and untreated solid manure is held constant in order to prevent implausible trends.

Table 252: Share of composted and untreated solid manure for cattle and swine in Austria in 1990, 2005 and 2011.

	1990		**2005**		**2011**	
	Composted solid manure [%]	**Untreated solid manure [%]**	**Composted solid manure [%]**	**Untreated solid manure [%]**	**Composted solid manure [%]**	**Untreated solid manure [%]**
Dairy cows	5.95	94.05	11.90	88.10	13.09	86.91
Suckling cows	5.85	94.15	11.70	88.30	12.87	87.13
Cattle < 1 year	5.90	94.10	11.80	88.20	12.98	87.02
Breeding heifers 1–2 years	5.90	94.10	11.80	88.20	12.98	87.02
Fattening heifers, bulls & oxen, 1–2 years	4.40	95.60	8.80	91.20	9.68	90.32
Cattle > 2 years	5.70	94.30	11.40	88.60	12.54	87.46
Breeding sows plus litter	6.35	93.65	12.70	87.30	13.97	86.03
Fattening pigs	4.20	95.80	8.40	91.60	9.24	90.76

Table 253: Slurry storage and treatment for cattle and swine in 1990, 2005 and 2011.

	Dairy cows	**Suckling cows** [1]	**Cattle < 1 year**	**Breeding heifers 1–2 years**	**Fattening heifers, bulls & oxen, 1–2 years**	**(Other) cattle > 2 years**	**Breeding Sows plus litter**	**(Young &) Fattening Pigs**
1990								
Solid cover	73.4	76.8	78.2	74.9	79.5	78.2	83.9	74.5
Uncovered and not aerated	14.1	12.2	10.3	15.9	11.3	9.4	10.8	16.3
Uncovered and aerated	5.7	5.8	6.8	4.2	4.1	8.2	2.6	1.9
Straw cover	0	0	0	0.1	0	0.1	0.3	0.4
Plastic foil	0	0	0	0	0	0	0.1	0.4
Natural crust	6.9	5.2	4.8	5.0	5.1	4.2	2.4	6.5
2005								
Solid cover	70.5	73.9	74.8	72.8	77.5	74.1	82.6	73.6
Uncovered and not aerated	11.2	9.3	6.9	13.8	9.3	5.3	9.5	15.4
Uncovered and aerated	11.4	11.5	13.5	8.3	8.2	16.3	5.1	3.7
Straw cover	0	0	0	0.1	0	0.1	0.3	0.4
Plastic foil	0	0	0	0	0	0	0.1	0.4
Natural crust	6.9	5.2	4.8	5.0	5.1	4.2	2.4	6.5
2011								
Solid cover	69.9	73.4	74.1	72.4	77.1	73.3	82.3	73.4
Uncovered and not aerated	10.6	8.7	6.2	13.4	8.8	4.5	9.2	15.2
Uncovered and aerated	12.5	12.7	14.9	9.1	9.0	17.9	5.6	4.1
Straw cover	0	0	0	0.1	0	0.1	0.3	0.4
Plastic foil	0	0	0	0	0	0	0.1	0.4
Natural crust	6.9	5.2	4.8	5.0	5.1	4.2	2.4	6.5

[1] *values from TIHALO for suckling cows had to be replaced by mean values of all other classes of cattle because of wrong values for aeration*

Note: The values for 2005 are taken from the TIHALO survey (AMON et al. 2007). Those for 1990 were estimated by Alfred Pöllinger in June 2008 on the basis of TIHALO results. The data from 2005-2008 were derived by linear extrapolation and from 2008 onwards it is held constant in order to prevent implausible trends.

Spreading technologies

Table 254 gives information on slurry application for the years 1990, 2005 and 2011. The values for the year 1990 are expected to be the half of the ones in 2005 (expert estimation by Alfred Pöllinger, June 2008).

Table 254: Cattle and pig slurry application in Austria 1990, 2005 and 2011.

Animal category:	**1990**		**2005**		**2011**	
	Broadcast application (%)	**Band spreading (%)**	**Broadcast application (%)**	**Band spreading (%)**	**Broadcast application (%)**	**Band spreading (%)**
Dairy cows	96.2	3.8	92.4	7.6	91.6	8.4
Suckling cows	97.1	2.9	94.2	5.8	93.6	6.4
Cattle < 1 year	96.6	3.5	93.1	6.9	92.4	7.6
Breeding heifers 1-2 years	96.3	3.7	92.6	7.4	91.9	8.1
Fattening heifers, bulls & oxen, 1-2 years	98.4	1.7	96.7	3.3	96.4	3.6
Cattle > 2 years	94.7	5.3	89.4	10.6	88.3	11.7
Breeding sows plus litter	98.0	2.1	95.9	4.1	95.5	4.5
Fattening pigs	97.0	3.0	94.0	6.0	93.4	6.6

The findings of TIHALO (AMON et al. 2007) show that sleigh foot application and slurry injection apparently do not exist in Austria's agriculture. Only a small percentage of slurry is applied with band spreading technologies.

6.2.2.2 Country specific data on animal excretion

N excretion

N excretion values as shown in Table 255 and Table 256 are based on the following literature: (GRUBER & PÖTSCH 2006, PÖTSCH et al. 2005, STEINWIDDER & GUGGENBERGER 2003, UNTERARBEITSGRUPPE N-ADHOC 2004 and ZAR 2004).

Table 255: Austria specific N excretion values of dairy cows for the period 1990–2011.

Year	**Milk yield [kg yr^{-1}]**	***Nitrogen excretion [kg/animal*yr]***	***Year***	**Milk yield [kg yr^{-1}]**	***Nitrogen excretion [kg/animal*yr]***
1990	3 791	76.62	2001	5 394	91.05
1991	3 800	76.70	2002	5 487	91.89
1992	3 905	77.64	2003	5 638	93.24
1993	3 948	78.03	2004	5 802	94.72
1994	4 076	79.18	2005	5 783	94.55
1995	4 619	84.07	2006	5 903	95.63
1996	4 670	84.53	2007	5 997	96.48
1997	4 787	85.58	2008	6 059	97.03
1998	4 924	86.82	2009	6 068	97.11
1999	5 062	88.06	2010	6 100	97.40
2000	5 210	89.39	2011	6 227	98.54

$^{1)}$ *From 1995 onwards data have been revised by Statistik Austria, which led to significant higher milk yield data of Austrian dairy cows.*

According to the requirements of the European nitrate directive, the Austrian N excretion data were recalculated following the guidelines of the European Commission. The revised nitrogen excretion coefficients were calculated based on following input parameters:

Cattle: Feed rations represent data of commercial farms consulting representatives of the working groups "Dairy production". These groups are managed by well-trained advisors. Their members, i.e. farmers, regularly exchange their knowledge and experience. Forage quality is based on field studies, carried out in representative grassland and dairy farm areas. The calculations depend on feeding ration, gain of weight, nitrogen and energy uptake, efficiency, duration of livestock keeping etc. On the basis of a new study (HÄUSLER 2009) for suckling cows an average milk yield of 3 500kg has been assumed for the years from 2004 onwards.

Table 256: Austria specific N excretion values of other cattle and swine.

Livestock category	***Nitrogen excretion* [kg/animal*yr]**
suckling cows[1] (1990)	69.5
suckling cows[2] (2011)	74.0
cattle 1–2 years	53.6
cattle < 1 year	25.7
cattle > 2 years	68.4
breeding sows	29.1
fattening pigs	10.3

[1] *Annual milk yield: 3 000 kg*

[2] *Annual milk yield: 3 500 kg*

Pigs: breeding pigs, piglets, boars, fattening pigs: number and weight of piglets, daily gain of weight, energy content of feeding, energy and nitrogen uptake, N-reduced feeding.

TAN content in excreta

The detailed methodology makes use of the total ammoniacal nitrogen (TAN) when calculating emissions. The initial share of TAN must be known as well as any transformation rates between organic N and TAN. TAN content for Austrian cattle and pig manure is given in Schechtner (1991). Due to the improved data availability, the inventory revision estimates for the first time emissions from composted farmyard manure. The TAN content of composted farmyard manure was taken from BMLFUW (2006b).

Table 257: TAN content for Austrian cattle and pig manure after SCHECHTNER (1991) and BMLFUW (2006b) in case of composted farmyard manure.

	TAN content [kg NH_4-N per kg Nex]
cattle – farmyard manure	0.15
cattle – liquid manure	0.50
swine – farmyard manure	0.15
swine – liquid manure	0.65
composted farmyard manure	(<) 0.01

6.2.2.3 Calculation of NH_3 emissions

NH_3 emissions from cattle and swine were calculated using a country specific methodology.

Emissions of Ammonia (NH_3) occur during animal housing (1), the storage of manure (2) and the application of organic fertilizers on agricultural soils (3). Emissions of nitric oxide (NO_x) were calculated for manure management and field spreading of manure (4).

Total NH_3 emissions from Category *4.B.1* and *4.B.8* are calculated as follows:

$$NH_{3\ Total} = NH_{3\ (housing)} + NH_{3\ (storage)} + NH_{3\ (spreading)}$$

Where no national emission factors were available, emission factors were taken from the Swiss ammonia inventory which is calculated with the computer based programme "DYNAMO" (MENZI et al. 2003, REIDY et al. 2007, REIDY & MENZI 2005). Due to similar management strategies and geographic structures, Swiss animal husbandry is closest to Austrian animal husbandry.

I. NH_3 emissions from housing (cattle and swine)

Table 258 gives NH_3 emission factors for emissions from animal housing. As far as possible, Swiss default values as given in the EMEP/CORINAIR atmospheric emission inventory guidebook have been chosen. Due to similar management strategies and geographic structures, Swiss animal husbandry is closest to Austrian animal husbandry. If no CORINAIR emission factors from Switzerland were available, the CORINAIR German default values were used.

Table 258: Emission factors for NH_3 emissions from animal housing.

Manure management system	CORINAIR Emission factor [kg NH_3-N (kg N excreted)$^{-1}$]
Pasture/range/paddock - cattle	0.050
Cattle, tied systems, liquid slurry system	0.040
Cattle, tied systems, solid storage system	0.039
Cattle, loose houses, liquid slurry system	0.118
Cattle, loose houses, solid storage system	0.118
Fattening pigs, liquid slurry system	0.150
Fattening pigs, solid storage system	15% of total N + 30% of the remaining TAN
Sows plus litter, liquid slurry system	0.167
Sows plus litter, solid storage system	0.167

For yards the swiss emission factor has been taken (KECK 1997, MISSELBROOK et al 2001) as used in DYNAMO (MENZI et al. 2003, REIDY et al. 2007, REIDY & MENZI 2005).

Table 259: NH_3 emission factors for yards.

Manure management system	DYNAMO Emission factor [kg NH_3-N (kg TAN)$^{-1}$]
Cattle, yard	0.8

N excretion per manure management system

Country-specific N excretion per animal waste management system for Austrian cattle and swine has been calculated using the following formula:

$$Nex_{(AWMS)} = \sum_{(T)} [N_{(T)} \times Nex_{(T)} \times AWMS_{(T)}]$$

$Nex_{(AWMS)}$ = *N excretion per animal waste management system [kg yr^{-1}]*

$N_{(T)}$ = *number of animals of type T in the country (see Table 246, Table 247 and Table 248)*

$Nex_{(T)}$ = *N excretion of animals of type T in the country [kg N animal^{-1} yr^{-1}] (see Table 255, Table 256 and Table 266)*

$AWMS_{(T)}$ = *fraction of $Nex_{(T)}$ that is managed in one of the different distinguished animal waste management systems for animals of type T in the country*

(T) = *type of animal category*

II. NH_3 emissions from manure storage (cattle and swine)

NH_3 emissions from storage are estimated from the amount of N left in the manure when the manure enters the storage. This amount of N is calculated as following:

From total N excretion the N excreted during grazing and the NH_3-N losses from housing (see above) are subtracted. The remaining N enters the store.

III. NH_3 emission factors (cattle and swine)

NH_3-N losses are estimated with CORINAIR default emission factors given in *Table 260*.

Table 260: NH_3 emission factors for manure storage.

Manure storage system	CORINAIR Emission factor [kg NH_3-N (kg TAN)$^{-1}$]
Cattle, liquid slurry system	0.15
Cattle, solid storage system	0.30
Pigs, liquid slurry system	0.12
Pigs, solid storage system	0.30

* *15% + 0.3 % of remaining TAN for deep litter (as used for fattening pigs in agriculture), otherwise 15% for daily removal of solid manure*

IV. Correction factors (cattle and swine)

Table 261 shows correction factors (CF) to emission factors (EF) for a range of manure treatment options. Untreated variants systems, for example uncomposted solid manure, give the reference value '1'. EF for other treatment options, managements and systems get an associated CF, e.g. +20% for the composting of solid manure (CF = 1.2). The CF is multiplied with the EF. Factors were taken from the Swiss ammonia inventory which is calculated with the computer based programme 'DYNAMO' (MENZI et al. 2003, REIDY et al. 2007, REIDY & MENZI 2005). Due to similar management strategies and geographic structures, Swiss animal husbandry is closest to Austrian animal husbandry.

DYNAMO is based on the N flow model and estimates ammonia emissions for each stage of the manure management continuum. Animal categories, manure management systems and a range of additional parameters are considered within DYNAMO. DYNAMO parameters were adapted to Austrian specific conditions. The DYNAMO model is peer reviewed by the EAGER[146] group and published in (REIDY et al. 2008, 2009).

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[146] European Agricultural Gaseous Emissions Inventory Researchers Network (EAGER)

Table 261: Correction factors (CF) for NH_3 emissions from manure storage.

Manure storage	[CF]
Uncomposted solid manure	1
Composted solid manure	1.2
Uncovered tank	1
Solid cover – liquid system	0.2
Aerated open tank – liquid system	1.1
Straw cover – liquid system	0.6
Plastic foil cover – liquid system	0.4
Natural crust – liquid system	0.6

V. NH_3 emissions from manure application (cattle and swine)

A country specific methodology has been applied.

This method distinguishes between the types of waste produced by each animal sub category: solid manure and liquid slurry. This is relevant, because TAN contents and therefore NH_3 emissions are highly dependent on the quality of waste and organic matter content in slurry. Furthermore, in the revised Austrian inventory the band spreading application of liquid manure has been taken into account.

NH_3 emissions from manure nitrogen applied to soils have been calculated using the following formula:

$$\mathbf{NH_3\text{-}N_{spread} = N_{exLFS} * (Frac_{SS} * F_{TAN\ SS} * EF\text{-}NH_3\text{-}N_{spread\ SS} + Frac_{LS\text{-}bc} * F_{TAN\ LS} * EF\text{-}NH_3\text{-}N_{spread\ LS} + Frac_{LS\text{-}bs} * F_{TAN\ LS} * EF\text{-}NH_3\text{-}N_{spread\ LS} * CF_{bs})}$$

$NH_3\text{-}N_{spread}$ = *NH_3-N emissions driven by intentional spreading of animal waste from Manure Management systems on agricultural soils (droppings of grazing animals are not included!)*

N_{exLFS} = *Annual amount of nitrogen in animal excreta left for spreading on agricultural soils, corrected for losses during manure management; it does not include nitrogen from grazing animals*

$Frac_{SS}$ = *Fraction of nitrogen left for spreading produced as farmyard manure in a solid waste management system*

$Frac_{LS\text{-}bc}$ = *Fraction of nitrogen left for spreading produced as liquid slurry in a liquid waste management system (broadcast spreading)*

$Frac_{LS\text{-}bs}$ = *Fraction of nitrogen left for spreading produced as liquid slurry in a liquid waste management system (band spreading)*

CF_{bs} = *Correction factor band spreading*

$F_{TAN\ SS}$ = *Fraction of total ammoniacal nitrogen (TAN) in animal waste produced in a solid waste management system*

$F_{TAN\ LS}$ = *Fraction of total ammoniacal nitrogen (TAN) in animal waste produced as slurry in a liquid waste management system*

$EF\text{-}NH_3\text{-}N_{spread\ SS}$ = *NH_3-N Emission factor of animal waste from a solid manure system (farmyard manure) spread on agricultural soils (broadcast spreading)*

$EF\text{-}NH_3\text{-}N_{spread\ LS}$ = *NH_3-N Emission factor of animal waste from a liquid slurry waste management system spread on agricultural soils (broadcast spreading)*

Nitrogen left for spreading

After housing and storage, manure is applied to agricultural soils. Manure application is connected with NH_3-N, NO_x-N and N_2O-N losses that depend on the amount of manure N. With regard to a comprehensive treatment of the nitrogen budged, Austria established a link between the ammonia and nitrous oxide emissions inventory. A detailed description of the methods applied for the calculation of N_2O emissions is given in the report "Austria's National Inventory Report 2013 – Submission under the United Nations Framework Convention on Climate Change and the Kyoto Protocol" (UMWELTBUNDESAMT 2013a).

From total N excretion the following losses were subtracted:

- N excreted during grazing
- NH_3-N losses from housing
- NH_3-N losses during manure storage
- NO_x-N losses from manure management
- N_2O-N losses from manure management
- The remaining N is applied to agricultural soils.

NH_3 emission factors

The following default NH_3 emission factors for spreading of slurry and farmyard manure (expressed as share of TAN) have been used:

Table 262: Emission factors for NH_3 emissions from animal waste application.

Application technique	CORINAIR Emission factor [kg NH_3-N (kg TAN)$^{-1}$]
spreading solid manure cattle	0.79
spreading solid manure pigs	0.81
broadcast spreading liquid manure cattle	0.50
broadcast spreading liquid manure pigs	0.25

For spreading of cattle and pig solid manure the emission factors from the updated version of the EMEP/CORINAIR atmospheric emission inventory guidebook have been taken (see EEA 2009, Table 3-8).

Correction factors

Table 263 presents the correction factor (CF) for band spreading. The CF is multiplied with the EF of broadcast spreading (reference value: 1). Factors were taken from the Swiss computer based programme "DYNAMO" (MENZI et al. 2003, REIDY et al. 2007, REIDY & MENZI 2005).

Table 263: Correction factors for NH_3 emissions from animal waste application.

Application technique	[CF]
Broadcast spreading	1
Band spreading	0.7

6.2.3 NH_3 emission from sheep (4 B 3), goats (4 B 4), horses (4 B 6), poultry (4 B 9) and other animals (4 B 13)

Key Sources: 4 B 9 – Poultry (NH_3)

The CORINAIR simple methodology was applied. Table 264 presents the recommended ammonia emission factors for the different livestock categories given in the EMEP/CORINAIR atmospheric emission inventory guidebook (EEA 2007, Table 4.1). Emission factors include emissions from housing, storage and surface spreading of waste.

Table 264: CORINAIR default ammonia emission factors (simple methodology)(1)

NFR	Livestock category	Housing [kg NH_3 head^{-1} yr^{-1}]	Storage [kg NH_3 head^{-1} yr^{-1}]	Spreading [kg NH_3 head^{-1} yr^{-1}]
4 B 3	Sheep	0.24	0.00	0.22
4 B 4	Goats	0.24	0.00	0.22
4 B 6	Horses (mules, asses)	2.90	0.00	2.20
4 B 9	Laying hens	0.19	0.03	0.15
4 B 9	Other Poultry (ducks, geese, turkeys)	0.48	0.06	0.38
4 B 13	Other animals	0.24	0.00	0.22

(1) *Emissions are expressed as kg NH_3 per animal, as counted in the annual agricultural census*

The EMEP/CORINAIR guidebook does not give default values for NH_3 emissions from the livestock category 'other animals'. In Austria furred game, mainly deer, dominates this livestock category. As sheep is the most similar livestock category to deer, for 'other animals' the NH_3 emission factor of sheep is used.

6.2.4 NO_x emissions from manure management (4 B)

NO_x emissions from *4 B Manure Management* are calculated as follows:

$$NO_{X\ Total} = NO_{X\ (housing\ \&\ storage)} + NO_{X\ (spreading)}$$

- NO_x emissions from housing & storage were calculated using the default Tier 1 emission factors per animal category as outlined in the EMEP/ EEA emission inventory guidebook 2009 (EEA 2009, Table 3-2).
- NO_x emissions from animal manure spreading are not addressed explicitly in the CORINAIR Guidebook. Thus, a conservative emission factor of 0.01 t NO_x-N per ton of organic fertilizer-N spread on agricultural soils is used (FREIBAUER & KALTSCHMITT 2001).

Table 265: NO_x emissions from manure management (housing, storage, spreading).

[Mg NO_X]	1990	1995	2000	2005	2010	2011
Housing & storage	310.23	286.88	255.00	231.56	225.92	221.60
Manure spreading	4 787.18	4 785.47	4 527.54	4 359.07	4 418.31	4 353.80
4 B Total	**5 097.41**	**5 072.34**	**4 782.54**	**4 590.63**	**4 644.23**	**4 575.41**

N excretion values applied for other livestock categories are presented in the following table:

Table 266: Austria specific N excretion values of other livestock categories.

Livestock category	***Nitrogen excretion* [kg/animal*yr]**
sheep	13.1
goats	12.3
horses	47.9
chicken[1)]	0.52
other poultry[2)]	1.1
other livestock/deer[3)]	13.1

[1)] Weighted average of hens and broilers

[2)] Weighted average of turkeys and other (ducks, gooses)

[3)] N-ex value of sheep applied

N excretion values of cattle and swine are presented in Table 256.

6.2.5 Recalculations

4 B 6 Horses, 4 B 9 Poultry, 4 B 13 Other

Animal numbers of horses, poultry and other animals have been updated with new activity data from the 2010 Agricultural Structure Survey. This update resulted in an increase of 2010 emissions from other animals (furred game, mainly deer) and poultry (chicken and other poultry) and a decrease of 2010 emissions from horses (NH_3 and NO_X).

Improvement of methodologies and emission factors

In 2012 the agriculture sector was validated. Some minor inconsistencies with respect to the AWMS data used in the greenhouse gas inventory were found and corrected. The validation resulted in a deviation from previous NH_3 and NO_X emissions by < 0.2 %.

6.3 NFR 4 D Agricultural Soils

NFR sector *4 D Agricultural Soils* includes emissions of ammonia (NH_3), nitrogen oxide (NO_x) and particulate matter (TSP, PM). The methodology for estimating PM emissions is presented in a separate chapter (chapter 6.6).

6.3.1 Methodological Issues

Under source category 4 D NH_3 and NO_x emissions from synthetic fertilizer application are reported (4 D 1 a). NH_3 emissions from grazing are reported under 4 D 2 c. In compliance with the EMEP/CORINAIR Guidebook, NH_3 emissions from manure application on agricultural soils are reported under source category *4 B manure management.*

Activity Data

Detailed data about the use of different kind of fertilizers are available until 1994, because until then, a fertilizer tax („Düngemittelabgabe“) had been collected. Data about the total mineral fertilizer consumption are available for amounts (but not for fertilizer types) from the statistical office (Statistik Austria) and from an agricultural marketing association (Agrarmarkt Austria, AMA). Annual sales figures about urea are available for the years 1994 onwards from a leading fertilizer trading firm (RWA). These sources were used to get a time series of annual fertilizer application distinguishing urea fertilizers and other N-fertilizers (“mineral fertilizers”).

High inter-annual variations in N_2O emissions of sector 4 D mineral fertilizer use are caused by the effect of storage: Fertilizers have a high elasticity to prices. Sales data are changing very rapidly due to changing market prices. Not the whole amount purchased is applied in the year of purchase. The fertilizer tax intensified this effect at the beginning of the 1990ies. Considering this effect, the arithmetic average of each two years is used as fertilizer application data.

The time series for fertilizer consumption is presented in Table 267.

Table 267: Mineral fertilizer N consumption in Austria 1990–2011 and arithmetic average of each two years.

Year	Annual Nutrient Sales Data [t N/yr]	of which Urea	Data Source	Weighted Nutrient Consumption [t N/yr]	Weighted Urea Consumption [t N/yr]
1989	133 304	1 700	FAO		
1990	140 379	3 965	estimated GB	136 842	2 833
1991	180 388	3 965	GB	160 384	3 965
1992	91 154	3 886	GB	135 771	3 926
1993	123 634	3 478	GB	107 394	3 682
1994	177 266	4 917	GB	150 450	4 198
1995	128 000	5 198	RWA	152 633	5 058
1996	125 300	4 600	RWA	126 650	4 899
1997	131 800	6 440	RWA	128 550	5 520
1998	127 500	6 440	RWA	129 650	6 440
1999	119 500	6 808	RWA	123 500	6 624
2000	121 600	3 848	GB, RWA	120 550	5 328
2001	117 100	3 329	GB, RWA	119 350	3 589
2002	127 600	4 470	GB, RWA	122 350	3 900
2003	94 400	6 506	GB, RWA	111 000	5 488
2004	100 800	7 293	GB, RWA	97 600	6 900
2005	99 700	7 673	GB, RWA	100 250	7 483
2006	103 700	11 310	GB, RWA	101 700	9 491
2007	103 300	11 500	GB, RWA	103 500	11 405
2008	134 400	9 568	GB, RWA	118 850	10 534
2009	86 300	18 400	GB, RWA	110 350	13 984
2010	90 629	6 500	GB, RWA	88 465	12 450
2011	116 751	16 867	GB, RWA	103 690	11 683

GB: (BMLFUW 2000–2012): www.gruenerbericht.at

RWA: Raiffeisen Ware Austria, sales company

6.3.2 Synthetic N-fertilizers (NFR 4 D 1 a)

Key source: NH_3

For the calculation of NH_3 emissions from synthetic fertilizers the CORINAIR detailed methodology was applied. This method uses specific NH_3 emission factors for different types of synthetic fertilizers and for different climatic conditions. According to CORINAIR, Austria belongs to Group III '*temperate and cool temperate countries*' with largely acidic soils.

In Austria, full time-series data only for urea and non-urea synthetic N fertilizers (see Table 267), but with no further specifications, are available. For urea the CORINAIR default value of 0.15 t NH_3-N per ton of fertilizer-N was applied. As calcium-ammonium-nitrate and ammonium-nitrate fertilizers represent the dominant form of non-urea synthetic fertilizers being used (FREIBAUER & KALTSCHMITT 2001), an average emission factor of 0.02 t NH_3-N per ton of fertilizer-N is applied for fertilizers other than urea (STREBL et al. 2003).

Emissions of nitric oxide (NO_x)

The CORINAIR simple methodology is applied. Emissions of NO_x are calculated as a fixed percentage of total fertilizer nitrogen applied to soil. For all mineral fertilizer types the CORINAIR recommended emission factor of 0.3% (i.e. 0.003 t NO_x-N per ton applied fertilizer-N) is used.

6.3.3 N-excretion on pasture, range and paddock (NFR 4 D 2 c)

Key source: No

Cattle and Swine

The CORINAIR emission factor of 0.05 kg NH_3-N/ kg N excreted has been used (Eidgenössische Forschungsanstalt 1997).

The share of N excreted on pastures is presented in Table 249 to Table 251. Free range systems for pigs are uncommon in Austria and were therefore not estimated in the inventory revision.

Nitrogen excretion values of cattle and swine are presented in Table 256.

Sheeps, goats, horses, poultry and other animals

The CORINAIR simple methodology (EEA 2007, Table 4.1) uses an average emission factor per animal for each livestock category (see Table 268):

Table 268: CORINAIR default ammonia emission factors (simple methodology)

NFR	Livestock category	NH_3 loss grazing [kg NH_3 head^{-1} yr^{-1}]
4.B.3	Sheep	0.88
4.B.4	Goats	0.88
4.B.6	Horses (mules and asses included)	2.90
4.B.9	Laying hens	0.00
4.B.9	Other Poultry (ducks, geese, turkeys)	0.00
4.B.13	Other animals (deer)$^{(1)}$	0.88

The emission factor of sheep has been used

6.3.4 Recalculations

Recalculated emissions for the year 2010 are the result of updated amounts of organic fertilizer application due to the inclusion of updated livestock numbers of horses, poultry and other animals.

6.4 NFR 4 G Agriculture – Other

Key Source: No

6.4.1 Methodological Issues

In NRF category 4 G the following sources are included:

- NH_3 and NO_x-emissions from sewage sludge spreading
- NH_3 emissions from legume cropland
- NMVOC emissions from vegetation
- PM emissions from animal husbandry

PM emissions from animal husbandry are presented in a separate chapter (chapter 6.7).

6.4.1.1 Sewage Sludge Application

Amonnia emissions (NH_3)

The CORINAIR emission factor of urea (EEA 2007, Table 5.1) has been taken (0.15 kg NH_3-N/kg fertilizer N).

Emissions of nitric oxide (NO_x)

NO_x emissions were estimated using a conservative emission factor of 1% of manure and sewage sludge nitrogen (FREIBAUER & KALTSCHMITT 2001).

Activity Data

Agriculturally applied sewage sludge data were taken from Water Quality Report 2000 (PHILIPPITSCH et al. 2001), Report on sewage sludge (UMWELTBUNDESAMT 1997) and (GEWÄSSERSCHUTZBERICHT 2002). For 2001 to 2011 data from the National Austrian Waste Water Database operated by the Umweltbundesamt was used (UMWELTBUNDESAMT 2011b, 2012a).

In the frame of the reporting obligation under the Urban Wastewater Directive (91/271/EEC) the annual amount of sewage sludge as ton dry substance per year (t DS/a) is collected by the authorities of the Austrian Provincial Governments. After quality assessment and aggregation the data are reported once a year to the National authorities.

Table 269: Amount of sewage sludge (dry matter) produced in Austria, 1990–2011.

Year	Total [t dm]	agriculturally applied [t dm]	agriculturally applied [%]
1990	161 936	31 507	19.5
1991	161 936	31 507	19.5
1992	200 000	30 000	15.0
1993	300 000	45 000	15.0
1994	350 000	38 500	11.0
1995	390 500	42 400	10.9
1996	390 500	42 955	11.0
1997	390 500	42 955	11.0
1998	392 909	43 220	11.0
1999	392 909	43 220	11.0
2000	392 909	43 220	11.0
2001	398 800	41 600	10.4
2002	322 096	36 065	11.2
2003	315 130	39 186	12.4
2004	294 942	35 357	12.0
2005	290 110	35 541	12.3
2006	241 364	39 369	16.3
2007	245 202	40 713	16.6
2008	248 169	39 247	15.8
2009	252 181	39 945	15.8
2010	262 805	44 354	16.9
2011	262 263	42 261	16.1

N content data of sewage sludge was obtained from (UMWELTBUNDESAMT 1997). The study contains sewage sludge analyses carried out by the Umweltbundesamt. Digested sludge samples from 17 municipal sewage sludge treatment plants taken in winter 1994/1995 were investigated with regard to more than one hundred inorganic, organic and biological parameters in order to get an idea of the quality of municipal sewage sludge. Following this study a mean value of 3.9% N in dry matter was taken.

In 2007 the N-content value of sewage sludge was re-examined. The comparison with national Studies (ZESSNER, M. 1999) and (ÖWAV-Regelblatt Nr. 17 – Landwirtschaftliche Verwertung von Klärschlamm 2004 – www.oewav.at) approved the value of 3.9% N/dm.

The amount of nitrogen input from agriculturally applied sewage sludge was calculated according following formula:

$$F_{Sslu} = Sslu_N * Sslu_{agric}$$

F_{Sslu} = *Annual nitrogen input to soils by agriculturally applied sewage sludge [t N]*

$Sslu_N$ = *Nitrogen content in dry matter [%] – 3.9%*

$Sslu_{agric}$ = *Annual amount of sewage sludge agriculturally applied [t/t] (see Table 269)*

6.4.1.2 Legume cropland

Amonnia emissions (NH_3)

The CORINAIR detailed methodology using the CORINAIR default emission factor of 0.01 t of NH_3-N per ton of N was applied. The amount of N-input to soils via N-fixation of legumes (F_{BN}) was estimated on the basis of the cropping areas and specific consideration of nitrogen fixation rates of all relevant N-fixing crops:

$$F_{BN} = LCA * B_{Fix}/1000$$

F_{BN} = *Annual amount of nitrogen input to agricultural soils from N-fixation by legume crops [t]*

LCA = *Legume cropping area [ha]*

B_{Fix} = *Annual biological nitrogen fixation rate of legumes [kg/ha]*

Activity values (LCA) can be found in Table 271.

Values for biological nitrogen fixation (120 kg N/ha for peas, soja beans and horse/field beans and 160 kg N/ha for clover-hey, respectively) were taken from (UMWELTBUNDESAMT 1998a); the values are constant over the time series.

(UMWELTBUNDESAMT 1998a) represents average data for Austria, which were used for calculating the Austrian Nitrogen Surface balance according to the OECD method. In the study available Austrian data and coefficients were put together, including literature and expert opinions from the Austrian "Fachbeirat für Bodenfruchtbarkeit und Bodenschutz" (advisory board for soil fertility and soil protection of the Federal Ministry for Agriculture and Forestry, Environment and Water Management). This advisory board is a platform of agricultural experts, which publishes regularly the "Richtlinien für die sachgerechte Düngung" (Austrian fertilizer recommendations).

6.4.1.3 NMVOC emissions from vegetation

CORINAIR simple methodology was applied. Biogenic emissions from vegetation canopies of natural grasslands are derived as described in the following equation (CORINAIR 1999, p. B 1104–7, Table 4.1). This method is also suggested to be applied for fertilized cultures.

$$E\text{-}NMVOC = CA * \varepsilon\text{-}NMVOC * D * \Gamma$$

E-NMVOC = *Annual NMVOC emissions from vegetation [t]*

CA = *Cropping area of vegetation [ha]*

ε–*NMVOC* = *NMVOC potential emission rate per unit of dry matter and time unit [mg/dry matter.hours]*

D = *Foliar biomass density [t dry matter/ha]*

Γ = *Time integral (over 6 or 12 months) of emission hours. This value includes a correction variable that represents the effect of short-term temperature and solar radiation changes [hours].*

Table 270: Parameters for calculation of NMVOC emissions from vegetation canopies of agriculturally used land.

	Effective emission hours(1) (12 mon)			Biomass Density D(2) [t/ha]	Emission Potential(3)		
	Γ-mts	Γ-ovoc [hours]	Γ–iso		ε–isoε-mtsε-ovoc [µg/g dry matter. hour]		
Grassland	734	734	540	0.4	0	0.1	1.5
Alpine grassland	734	734	540	0.2	0	0.1	1.5
Agricultural crops	734	734	540	0.617(4)	0.09	0.13	1.5

Abbreviations: iso = isopren; mts = terpene; ovoc = other VOC's

(1) *Γ = integrated effective emission hours, corrected to represent the effects of short term temperature and solar radiation changes on emissions*

(2) *D = foliar biomass density (in t dry matter per ha)*

(3) *ε = average emission potential*

(4) *based on cereal harvest data (2005-value see Table 272)*

The results are highly dependent on the assumptions about biomass density.

Aboveground biomass of agricultural crops was calculated using official cropping area (see Table 271) and expansion factors for leaves. For simplification, wheat was considered to be representative for the vegetation cover of agricultural crop land (see Table 272).

Activity data

The yearly numbers of the legume cropping areas were taken from official statistics (BMLFUW 2000–2012). Data of agricultural land use are taken from the datapool of (Bundesanstalt für Agrarwirtschaft 2012).

Table 271: Legume cropping areas and agricultural land use 1990–2011.

Year	Legume Areas [ha]				Land Use Areas [1000 ha]		
	peas	soja beans	horse/field beans	clover hey, lucerne, …	Cropland (total)	Grassland (total)	Grassland (extensive)
1990	40 619	9 271	13 131	57 875	1 408	1 993	846
1991	37 880	14 733	14 377	65 467	1 427	1 993	846
1992	43 706	52 795	14 014	64 379	1 418	1 993	846
1993	44 028	54 064	1 064	68 124	1 402	1 982	848
1994	38 839	46 632	10 081	72 388	1 403	1 982	848
1995	19 133	13 669	6 886	71 024	1 403	1 977	857
1996	30 782	13 315	4 574	72 052	1 403	1 977	857
1997	50 913	15 217	2 783	75 976	1 386	1 980	851
1998	58 637	20 031	2 043	76 245	1 386	1 980	851
1999	46 007	18 541	2 333	75 028	1 386	1 957	833
2000	41 114	15 537	2 952	74 266	1 382	1 957	833
2001	38 567	16 336	2 789	72 196	1 380	1 957	833
2002	41 605	13 995	3 415	75 429	1 379	1 957	833
2003	42 097	15 463	3 465	78 813	1 380	1 848	709

Year	Legume Areas [ha]				Land Use Areas [1000 ha]		
	peas	soja beans	horse/field beans	clover hey, lucerne, …	Cropland (total)	Grassland (total)	Grassland (extensive)
2004	39 320	17 864	2 835	83 349	1 379	1 848	709
2005	36 037	21 429	3 549	88 974	1 380	1 830	731
2006	32 652	25 013	4 555	97 549	1 377	1 830	731
2007	28 111	20 183	4 479	101 861	1 376	1 792	722
2008	22 306	18 419	3 695	98 966	1 369	1 792	722
2009	15 168	25 321	2 819	101 073	1 367	1 792	722
2010	13 562	34 378	4 154	106 080	1 364	1 792	722
2011	11 715	38 123	6 028	104 800	1 364	1 792	722

Table 272: Cereal production in Austria [t/ha].

Year	harvest per area	Year	harvest per area
	[t/ha]		[t/ha]
1990	5.58	2001	5.87
1991	5.46	2002	5.85
1992	5.16	2003	5.27
1993	5.10	2004	6.53
1994	5.40	2005	6.17
1995	5.51	2006	5.75
1996	5.40	2007	5.88
1997	5.92	2008	6.86
1998	5.70	2009	6.19
1999	5.95	2010	5.95
2000	5.42	2011	7.09

6.4.2 Recalculations

No recalculations have been carried out.

6.5 NFR 4 F Field Burning of Agricultural Waste

This category comprises burning straw from cereals and residual wood of vinicultures on open fields in Austria.

Burning agricultural residues on open fields in Austria is legally restricted by provincial law and since 1993 additionally by federal law and is only occasionally permitted on a very small scale. Therefore the contribution of emissions from field burning of agricultural waste to the total emissions is very low.

6.5.1 Methodological Issues

Activity Data

According to the Presidential Conference of the Austrian Chambers of Agriculture (personal communication to Mag. Längauer), in Austria about 959 ha were burnt in 2011. This value corresponds to about 0.2% of the relevant cereal area in 2011.

For 1990 an average value of 2 500 ha was indicated for Austria's main cultivation regions (Dr. Reindl 2004). The extrapolation to Austria's total cereal production area gave a value of 2 630 ha.

Activity data (viniculture area) are taken from the Statistical Yearbooks 1992–2002 (Statistik Austria) and the "Green Reports" of (BMLFUW 2000–2012). According to an expert judgement from the *Federal Association of Viniculture* (Bundesweinbauverband Österreich) the amount of residual wood per hectare viniculture is 1.5 to 2.5 t residual wood and the part of it that is burnt is estimated to be 1 to 3%. For the calculations the upper limits (3% of 2.5 t/ha) have been used resulting in a factor of 0.075 t burnt residual wood per hectare viniculture area.

Table 273: Activity data for field burning of agricultural residues 1990–2011.

Year	Viniculture Area [ha]	Burnt Residual Wood [t]
1990	58 364	4 377
1991	58 364	4 377
1992	58 364	4 377
1993	57 216	4 291
1994	57 216	4 291
1995	55 628	4 172
1996	55 628	4 172
1997	52 494	3 937
1998	52 494	3 937
1999	51 214	3 841
2000	51 214	3 841
2001	51 214	3 841
2002	51 214	3 841
2003	47 572	3 568
2004	47 572	3 568
2005	50 119	3 759
2006	50 119	3 759
2007	49 842	3 738
2008	49 842	3 738
2009	49 842	3 738
2010	46 635	3 498
2011	46 635	3 498

The amount of agricultural waste burned is multiplied with a default or a country specific emission factor.

6.5.1.1 Cereals

CO, NO_x

The IPCC default method was used. Carbon fractions and nitrogen fractions for wheat, barley, oats and rye were obtained from Table 4-16 of the IPCC good practice guidance (IPCC 2000). For dry matter fraction an Austrian specific value of 0.86 was used (LÖHR 1990). Residue/crop product ratio was obtained from (UMWELTBUNDESAMT 1998a). For CO an emission ratio of 0.06, for NO_x an emission ratio of 0.121 was used (IPCC 1997, Table 4-16).

NH_3

The CORINAIR detailed method with the default emission factor of 2.4 mg NH_3 per gram straw was used. For dry matter fraction the Austrian specific value of 0.86 was used (LÖHR 1990). Residue/crop product ratio for wheat, barley, oats and rye was obtained from (UMWELTBUNDESAMT 1998a).

SO_2

The CORINAIR detailed method and a national emission factor of 78 g per ton straw (dm) was applied. The emission factor corresponds to burning wood logs in poor operation furnace systems (JOANNEUM RESEARCH 1995). For dry matter fraction the Austrian specific value of 0.86 was used (LÖHR 1990). Residue/crop product ratio for wheat, barley, oats and rye was obtained from (UMWELTBUNDESAMT 1998a).

NMVOC

A simple national method with a national emission factor of 28 520 g NMVOC per ha burnt was applied (ÖFZS 1991).

Heavy metals (Cd, Hg, Pb)

The CORINAIR detailed method with national emission factors has been applied. The Hg, Cd, and Pb emission factors were taken from (HÜBNER 2001a):

- Cd .... 0.09 mg/kg dm_{straw}, 20% remaining in ash
- Pb .... 0.48 mg/kg dm_{straw}, 20% remaining in ash
- Hg .... 0.013 mg/kg dm_{straw}, 0% remaining in ash

The fraction of dry matter burned was estimated by applying the residue/crop product ratio of wheat, barley, oats and rye taken from (IPCC GPG Table 4-16). For the dry matter content of cereals an Austrian specific value of 0.86 was used (LÖHR 1990).

POPs (PAH, HCB, dioxin/furan)

A country specific method was applied (HÜBNER 2001b). National emission factors were taken from HÜBNER (2001b):

- PAH ....70 000 mg/ha
- PCDD/F ..50 µgTE/ha
- HCB ....10 000 µg/ha.
- *Particulate Matter (TSP, PM10, PM2.5)*

Emission factors related to the dry matter (dm) mass of residue burnt have been taken (JENKINS et al. 1996):

- TSP.........0.0058 kg/kg dm_{burnt}
- PM10..... 0.0058 kg/kg dm_{burnt}
- PM2.5.... 0.0055 kg/kg dm_{burnt}

6.5.1.2 Viniculture

SO_2, NO_x, NMVOC and NH_3

A country specific method was applied. National emission factors for SO_2, NO_x and NMVOC were taken from (JOANNEUM RESEARCH 1995). A calorific value of 7.1 MJ/kg burnt wood which corresponds to burning wood logs in poor operation furnace systems was used to convert the emission factors from [kg/TJ] to [kg/Mg]. For NH_3 the Corinair emission factor of 1.9 kg per ton burnt wood was taken. Table 274 presents the resulting emission factors.

Table 274: Emission factors for burning straw and residual wood of vinicultures.

	SO_2 [g/Mg Waste]	**NO_x [g/Mg Waste]**	**NMVOC [g/Mg Waste]**	**NH_3 [g/Mg Waste]**
Residual wood of vinicultures	78	284	14 200	1 900

Heavy metals (Cd, Hg, Pb)

A country specific method was applied: The dry matter content of residual wood was assumed to be 80%, national emission factors were taken from (HÜBNER 2001a):

- Cd ....0.37 mg/kg dm_{wood}, 20% remaining in ash
- Pb ....2.35 mg/kg dm_{wood}, 20% remaining in ash
- Hg ....0.038 mg/kg dm_{wood}, 0% remaining in ash

POPs (PAH, HCB, PCDD/F)

A country specific method was applied. The national emission factors per ton burnt wood were taken from (HÜBNER 2001b):

- PAH ....15.000 mg/Mg Waste
- PCDD/F ..12 µgTE/Mg Waste
- HCB .... 2 400 µg/Mg Waste

Particulate Matter (TSP, PM10, PM2.5)

The same methodology like for the estimation of PM emissions from bonfires (WINIWARTER et al. 2007) was applied. An emission factor of 1 500 g/GJ (similar to open fire places, expert guess from literature) was taken. Under the assumption of a heating value of 10 GJ per ton residual wood the following emission factor has been derived:

- $EF_{TSP} = EF_{PM10} = EF_{PM2.5} =$ 15kg/t residual wood

6.5.2 Recalculations

Activity data on viniculture areas have been updated for 2010, resulting in a slight decrease of emissions.

6.6 NFR 4 D Particle Emissions from Agricultural Soils

- Particle emissions reported under source category 4 D result from
  - certain steps of farm work such as soil cultivation and harvesting (field operations). The calculations are based on (WINIWARTER et al. 2007).
  - agricultural bulk material handling. These emissions are estimated under source category *2 A Mineral Products* (see chapter 4.3).

6.6.1 Methodological Issues

6.6.1.1 PM emissions from field operations

Emissions of particulate matter from field operations are linked with the usage of machines on agricultural soils. They are considered in relationship with the treated areas.

Activity Data

Agricultural land use data applied for the calculation of particle emissions are taken from the datapool of (BUNDESANSTALT FÜR AGRARWIRTSCHAFT 2012).

Table 275: Agricultural land use data 1990–2011.

Land Use Area Data					
Year	**arable farm land [1 000 ha]**	**Grassland (excl. mountain pastures [1 000 ha]**	**Year**	**arable farm land [1 000 ha]**	**grassland (excl. mountain pastures [1 000 ha]**
1990	1 408	1 147	2001	1 380	1 124
1991	1 427	1 147	2002	1 379	1 124
1992	1 418	1 147	2003	1 380	1 139
1993	1 402	1 133	2004	1 379	1 139
1994	1 403	1 133	2005	1 380	1 099
1995	1 403	1 120	2006	1 377	1 099
1996	1 403	1 120	2007	1 376	1 070
1997	1 386	1 129	2008	1 369	1 070
1998	1 386	1 129	2009	1 367	1 070
1999	1 386	1 124	2010	1 364	1 070
2000	1 382	1 124	2011	1 364	1 070

Due to the limited number of measurements, a separate parameterization of different field crops as well as a different treatment of cropland and grassland activities is not yet possible. Thus, as activity data the sum of cropland and grassland area (excluding extensiv mountain pastures) is used.

Emission factors

For the estimation of emissions from field operations an emission factor of 5kg/ha PM10 has been applied (ÖTTL & FUNK 2007). PM emissions occuring from harvesting have been calculated using an emission factor of 5kg/ha PM10 (HINZ & VAN DER HOEK 2006). Both emission factors are based on measurements carried out directly on the field (two meters above soil and on the harvester).

Emission factors reflect constant dry conditions and are consistant with other reported emission factors e.g. (EPA 1999). Nevertheless, resulting emissions would exceed their actual atmospheric occurrence. They are rather 'potential emissions' marking the upper boundaries. To get more reliable data, the wet situation in Austria has to be taken into account.

Wet conditions in Austria

Following Hinz, under wet conditions only a small part of the particle emissions stays in the atmosphere. In this inventory a value of 10% has been applied.

Operations under dry conditions

Dry weather conditions have been considered by the use of a variable climate factor. This factor represents the share of operations under dry conditions. As currently no solid data for operations under dry conditions is available, a share of 0.1 has been assumed. Activities under dry conditions cause 10 times higher emissions compared to wet conditions.

The calculations resulted in following emissions per hectar:

Table 276: Resulting implied PM emission factors.

Implied Emission Factor [g/ha]		
TSP	**PM10**	**PM2.5**
4 444	2 000	444

The following fractions have been used for conversation:

PM2.5 ....TSP*10%

PM10 ....TSP*45%

6.6.1.2 PM emissions from bulk material handling

The CORINAIR simple methodology was applied. Emissions were estimated multiplying the amount of bulk material by an emission factor. Activity data was taken from national statistics.

6.7 NFR 4 G Particle Emissions from Animal Husbandry

Particle emissions from this source are primary connected with the manipulation of forage, a smaller part arises from dispersed excrements and litter. Wet vegetation and mineral particles of soils are assumed to be negligible, thus particle emissions from free-range animals are not included.

6.7.1 Methodological Issues

The estimations of particle emissions from animal husbandry are related to the Austrian livestock number.

Activity data

The Austrian official statistics (STATISTIK AUSTRIA 2012b) provides national data of annual livestock numbers on a very detailed level.

Emission Factors

Measurements and emission estimates of 'primary biological aerosol particles' based on such measurements (WINIWARTER et al. 2007) don't indicate high amounts of cellulosic materials existing in the atmosphere. This is in contrast to the results of the first estimate approach following (EEA 2007) applied in the recent Austrian air emission inventory.

Due to the lack of more reliable up-to-date data, in this inventory the emission factors of the RAINS model (LÜKEWILLE et al. 2001) have been used, resulting in significant lower estimates.

In Table 277 the applied emission factors are listed.

Table 277: TSP emission factors animal housing.

Livestock	Emission Factor [kg TSP/animal]	Livestock	Emission Factor [kg TSP/animal]
Dairy cows	0.235	Laying hens	0.016
Other cattle	0.235	Broilers	0.016
Fattening pigs	0.108	Other poultry (ducks,gooses,etc.)	0.016
Sows	0.108	Goats	0.153
Ovines	0.235	Other	0.016
Horses	0.153		

Following (KLIMONT et al. 2002) the share of PM10 in TSP is assumed to be 45% and the share of PM2.5 in TSP is assumed to be 10%.

6.7.2 Recalculations

Animal numbers of horses, poultry and other animals have been updated with new activity data from the 2010 Agricultural Structure Survey, which results in slightly higher PM emissions for the year 2010.

6.8 Recalculations

Summary of recalculations made since submission 2012 (for details refer to sub-chapters):

- Updated animal numbers of horses, poultry and other animals for 2010;
- Updated data on viniculture areas for 2010;
- Revisions as a result of extensive QA and verification activities of sector agriculture in 2012.

7 WASTE (NFR SECTOR 6)

7.1 Sector Overview

This chapter includes information on and descriptions of methodologies applied for estimating emissions of NEC gases, CO, heavy metals, persistent organic pollutants (POPs) and particulate matter (PM), as well as references for activity data and emission factors concerning waste management and treatment activities reported under NFR Category *6 Waste* for the period from 1990 to 2011.

Emissions addressed in this chapter include emissions from the sub categories

- *Solid Waste Disposal on Land* (NFR Sector 6 A);
- *Wastewater Handling* (NFR Sector 6 B), where no emissions were reported;
- *Waste Incineration* (NFR Sector 6 C), which comprises the incineration of corpses, municipal waste and waste oil;
- *Other* (NFR Sector 6 D), which comprises composting as well as mechanical-biological treatment of waste.

NH_3 emissions of this source have been identified as key category. The following Table 278 presents the results of the Key Category Analysis of the Austrian inventory with regard to the contribution to national total emissions (for details of the Key Category Analysis see Chapter 1.4).

Table 278: Contribution to National Total Emissions from NFR sector 6 Waste in 2011.

Pollutant	Source Category: 6 Waste	Pollutant	Source Category: 6 Waste
SO_2	0.05%	PAH	< 0.01%
NO_x	0.01%	Diox	0.43%
NMVOC	0.05%	HCB	0.08%
NH_3	2.09%	TSP	0.28%
CO	0.71%	PM10	0.23%
Cd	0.06%	PM2.5	0.13%
Hg	2.02%		
Pb	0.01%		

The overall emission trend reflects changes in waste management policies as well as waste treatment facilities. According to the Landfill Ordinance[147] waste has to be treated before being deposited in order to reduce the organic carbon content. Decreasing amounts of deposited waste in turn result in decreasing NH_3 emissions. Although an increasing amount of waste is incinerated, NO_x, NMVOC and NH_3 emissions from 6.C. (waste incineration without energy recovery) are decreasing. Emissions arising from incineration of waste with energy recovery are taken into account in NFR Sector 1 A. NH_3 emissions arising from category 6.D Compost Production show an increasing trend due to increasing amounts of biologically treated waste, a result of the separate collection of organic waste (regulated in an Austrian act on collection of biogenic

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[147] Verordnung über die Ablagerung von Abfällen (Deponieverordnung), BGBl. Nr. 164/1996, BGBl. II Nr. 49/2004; geltende Fassung: Deponieverordnung 2008 (BGBl. II Nr. 39/2008).

waste[148]) and the since 2009 obligatory pre-treatment of waste[149] before deposition (regulated in Austrian Landfill Ordinance[150]).

The following list comprises primary and secondary measures which were implemented over the last years:

- Primary measures
  - waste avoidance in households: savings in packaging materials; returnable (plastic) bottles instead of non-returnable packages; intensive waste separation, composting of biological; reuse; separate collection of hazardous waste like solvents, paints or (car) batteries.
  - waste avoidance in industry and energy industry: waste separation regarding material, recyclable waste, hazardous waste; more efficient process lines; use of co- and by-product process line; (scap) recycling; substitution of raw material/fuel; reduction in use of raw material/fuel and additive raw material; higher product quality.
  - recycling of old cars (recycling certificate).
- Secondary measures
  - general strategy: waste avoidance prior to waste recycling/reuse prior to landfilling;
  - recovery of (recyclable) material from waste like steel and aluminium recycling, and recycling of paper, glass, plastic;
  - recovery of (recyclable) material from electronic waste;
  - composting of biogenic material;
  - mechanical-biological treatment of waste;
  - fermentation of biogenic material;
  - energetic use in waste incineration.

The following figure shows the main streams of treatment and disposal of waste from households and similar sources. It also aims to transparently show the distinction between residual and non-residual waste (with regard to municipal solid waste[151]) and to demonstrate that all relevant activity data are taken into account in the inventory.

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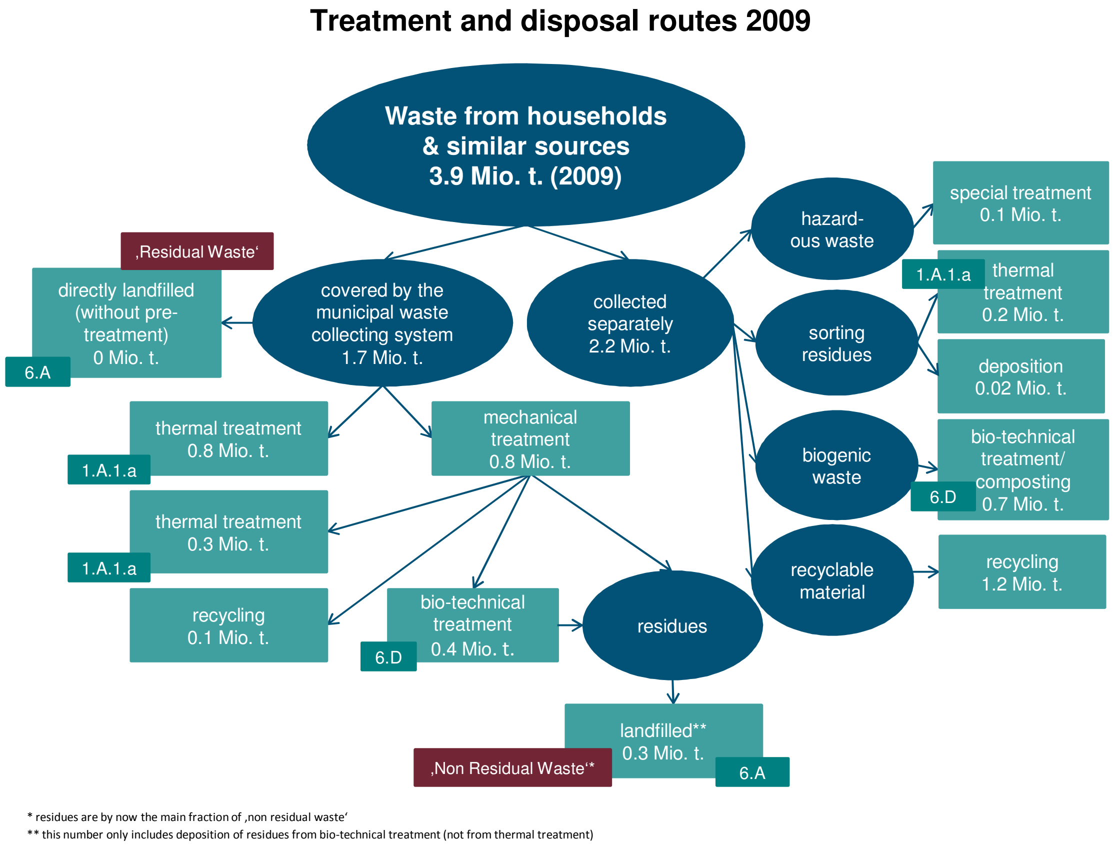
[148] Verordnung über die getrennte Sammlung biogener Abfälle (BGBl. Nr. 68/1992)

[149] Since 2004 respectively – without exemption – 2009 no waste is allowed to be deposited any more without being pre-treated (in thermal or bio-technical treatment plants)

[150] Deponieverordnung 1996 (BGBl. II Nr. 49/2004), Deponieverordnung 2008 (BGBl. II Nr. 39/2008)

[151] In fact non-residual waste also comprises waste from other (industrial) sources.



* residues are by now the main fraction of ‚non residual waste'

** this number only includes deposition of residues from bio-technical treatment (not from thermal treatment)

Source: BMLFUW (2011a), Umweltbundesamt

Figure 29: Main streams of treatment and disposal of waste from households and similar sources.

Almost 100% of waste from households and similar sources is incinerated, recycled or treated mechanical-biologically. In 2009 only sorting residues from potentially recyclable material collected separately (0.4% of total waste from households and similar categories) were directly deposited.

Table 279: Recycling and treatment of waste from households and similar sources.

Treatment	**1989 1)**	**1999 3)**	**2004 3)**	**2006 4)**	**2008 5)**	**2009 6)**
bio-technical treatment	16.7% 2)	6.3%	11.2%	17.9%	8.8%	10.4%
thermal treatment (incineration)	5.9%	14.7%	28.3%	23.7%	34.7%	36.4%
treatment in plants for hazardous waste	0.4%	0.8%	1.2%	1.8%	2.3%	2.4%
recycling	12.9%	34.3%	35.6%	34.8%	32.3%	31.7%
bio-technical treatment/composting	1.0%	15.4%	16.0%	17.9%	18.2%	18.7%
direct deposition at landfills	63.1%	28.5%	7.7%	3.8%	3.7%	0.4% *)

1) *Federal Waste Management Plan (BMLFUW 2001)*

2) *This value also includes plants used in the past to reduce odour emissions.*

3) *Federal Waste Management Plan (BMLFUW 2006a)*

4) *Annual update (2008) of the Federal Waste Management Plan (BMLFUW 2006a)*

5) *Annual update (2009) of the Federal Waste Management Plan (BMLFUW 2006a)*

6) *Federal Waste Management Plan (BMLFUW 2011)*

*) *solely sorting residues from potentially recyclable material collected separately.*

7.2 General description

7.2.1 Methodology

In general the CORINAIR simple methodology, multiplying activity data for each sub category with an emission factor, is applied. For waste disposal the IPCC methodology (FOD method) was used to calculate the amount of landfill gas, the methodology is described in detail below.

7.2.2 Completeness

Table 280 gives an overview of the NFR categories included in this chapter and also provides information on the status of emission estimates of all sub categories. A "✓" indicates that emissions from this sub category have been estimated.

Table 280: Overview of sub categories of Category 6 Waste and status of estimation.

NFR Category		**Status**													
		NEC gas				**CO**	**PM**			**Heavy metals**			**POPs**		
		NO_x	**SO_2**	**NH_3**	**NMVOC**	**CO**	**TSP**	**PM10**	**PM2.5**	**Cd**	**Hg**	**Pb**	**Dioxin**	**PAK**	**HCB**
6 A	Solid Waste Disposal on Land	NA	NA	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	NA	NA
6 B	Wastewater Handling	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6 C	Waste Incineration	✓	✓	✓	✓	✓	NE	NE	NE	✓	✓	✓	✓	✓	✓
6 D	Other Waste	NA	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

7.3 NFR 6 A Waste Disposal on Land

7.3.1 Managed Waste Disposal on Land (6 A 1)

Source Category Description

In Austria all waste disposal sites are managed sites (landfills).

NFR 6 A 1 *Managed waste disposal on land* accounts for the main source of NH_3 and NMVOC emissions of NFR Category 6 Waste.

In the Austrian inventory two main categories of waste are distinguished: residual waste and non-residual waste. Residual waste refers only to the part of municipal solid waste[152] collected by the municipal system (mixed composition) that is directly deposited without any pre-treatment. Non-residual waste comprises among others municipal solid waste having been pre-treated, sludges from wastewater treatment and waste from industrial sources.

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[152] i.e. waste from households as well as other waste which, because of its nature or composition, is similar to waste from household (Article 2 (b): Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste).

'Residual waste' corresponds to waste:

- originating from households and similar sources (private households, administrative facilities of commerce, industry and public administration, kindergartens, schools, hospitals, small enterprises, agriculture, market places and other generation points)
- remaining after separation of paper, glass, plastic etc. at the source
- covered by the municipal waste collecting system
- directly landfilled without having passed any pre-treatment

It has to be noted that from 2009 on no waste is allowed to be deposited any more without being pre-treated (due to the Landfill Ordinance[153]), so since 2009 no disposal of 'residual waste' is reported by landfill operators and therefore no new depositions of residual waste is taken into account in the inventory. Emissions from this subcategory are therefore only affected by historical depositions.

Waste from households and similar sources covered by the municipal waste collecting system but undergoing a pre-treatment before deposition is not included in this category, but in category "non-residual waste" (sub-category "sorting residues", among others from mechanical-biological treatment) and in sector "energy" respectively, as incineration is a pre-treatment option too.

- 'Non residual waste'
- comprises pre-treated waste from households (e.g. residues from mechanical-biological treatment) and waste with biodegradable lots from other (industrial) sources
- is divided into the categories wood, construction waste, paper, green waste, sludge, sorting residues/stabilized material (incl. bulky waste), textiles and fats

Stabilized material and sorting residues remaining after mechanical, biological and mechanical-biological treatment and bulky waste are the main fraction deposited (99%). Other fractions deposited are sludges (0.8%) and construction waste (0.2%). Bio waste, paper and wood are mainly composted, recycled or reused (due to the implementing of the Waste Management Law), fats and textiles are not deposited any more.

Methodological Issues

The anaerobic degradation of land filled organic substances results in the formation of landfill gas.

NMVOC and NH_3 emissions are calculated based on their respective content in the emitted landfill gas (after consideration of gas recovery). For NMVOC a concentration of 300 mg per m^3 landfill gas, for NH_3 a concentration of 10 mg per m^3 landfill gas is assumed.

The amount of generated landfill gas from disposed solid waste is calculated by taking into account:

- the amounts of deposited waste, reported by landfill operators for different waste categories,
- the carbon contents of each waste fraction and
- several other parameters, among others on landfill gas recovery[154].

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[153] Verordnung über die Ablagerung von Abfällen (Deponieverordnung), BGBl. Nr. 164/1996 in der Fassung BGBl. II Nr. 49/2004 Deponieverordnung 2008 (BGBl. II Nr. 39/2008)

[154] Most active landfills in Austria have gas collection systems – regulated in §31 Landfill Ordinance (Federal Gazette BGBl. Nr 39/2008.

For the calculation of emissions the IPCC Tier 2 method (First Order Decay) is applied, consisting of two equations: first, calculating the amount of methane accumulated up to the year of the inventory; second, calculating the emitted methane after subtracting the recovered and oxidised methane amounts. As far as available country-specific parameters are taken (e.g. the recovered landfill gas).

Activity data

For emissions calculation waste deposited from 1950 onwards has been taken into account.

Table 281: Activity data for "Residual waste" and "Non Residual Waste" 1990–2011.

Year	Non Residual waste [Mg]	Residual waste [Mg]	Total waste [Mg]
1990	648 702	1 995 747	2 644 448
1991	661 676	1 799 718	2 461 394
1992	674 909	1 614 157	2 289 067
1993	688 407	1 644 718	2 333 126
1994	702 175	1 142 067	1 844 242
1995	716 219	1 049 709	1 765 928
1996	730 543	1 124 169	1 854 713
1997	745 154	1 082 634	1 827 788
1998	760 057	1 081 114	1 841 171
1999	822 179	1 084 625	1 906 804
2000	826 874	1 052 061	1 878 935
2001	772 786	1 065 592	1 838 378
2002	792 753	1 174 543	1 967 296
2003	890 640	1 385 944	2 276 584
2004	344 747	282 656	627 403
2005	389 660	241 733	631 393
2006	425 091	260 068	685 159
2007	464 109	154 517	618 626
2008	319 927	129 324	449 251
2009	256 340	0	256 340
2010	244 786	0	244 786
2011	273 313	0	273 313
1990-2011	**- 58%**	**- 100%**	**- 90%**

In 1990 the Austrian Waste Management Law[155] entered into force. As a consequence, from 1990 to 1995, the amount of deposited waste decreased and waste separation and reuse as well as recycling activities increased. After 1994/1995 the potential of waste prevention and waste recycling was exhausted, so amounts of deposited waste did not decrease any further. The amount of deposited waste peaked in 2003 and then dropped as from the beginning of 2004 only pre-treated waste was allowed to be deposited. This is due to the implementation of

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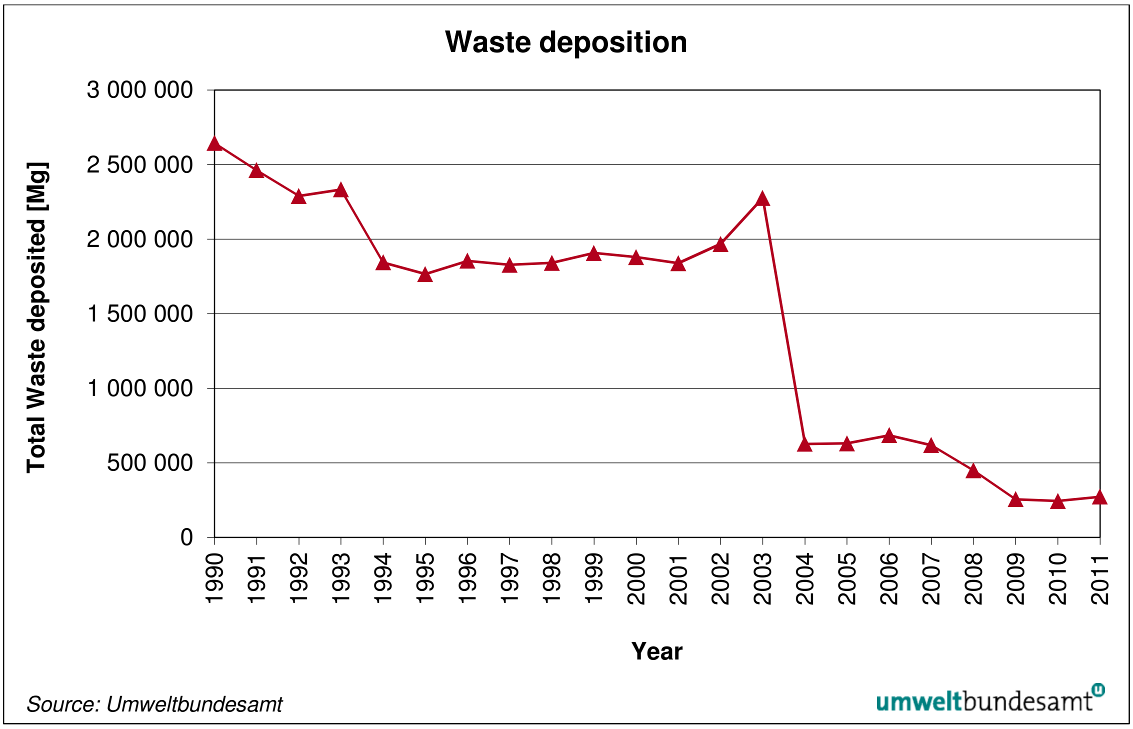
[155] Abfallwirtschaftsgesetz (AWG): BGBl. Nr. 325/1990, in der Fassung BGBl. I. Nr. 102/2002

the Landfill Ordinance[156], which prohibits the disposal of untreated waste and therefore leads to reduced waste volumes as well as decreased carbon content in deposited waste.

However, under certain circumstances there were some exceptions to this pre-treatment-obligation granted to some Austrian provinces.[157] In four of the nine Austrian provinces it was still allowed to deposit waste directly without any pre-treatment until the end of 2008. From 2009 on no residual waste[158] is allowed to be deposited any more.



Source: Umweltbundesamt

Figure 30: Deposited waste (residual and non residual waste) 1990–2011.

The quantities of "residual waste" have been taken from the following sources:

- Data for 2008-2011 have been taken from the EDM[159], an electronic database administered by the BMLFUW. Since the beginning of 2009 landfill operators are obliged to register their data directly and electronically (per upload) at the portal of http://edm.gv.at[161].
- Data for 1998-2007 were taken from a database for solid waste disposals called "Deponiedatenbank" ('Austrian landfill database'), a database administered and maintained by the Umweltbundesamt until the end of 2008.
- Data for 1950-1997 on the amounts of deposited residual waste were taken from national studies (Hackl & Mauschitz 1999, Umweltbundesamt 2001c) and the respective Federal Waste Management Plans (Bundesabfallwirtschaftplan 1995, 2001).

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[156] Deponieverordnung: BGBl. Nr. 164/1996, in der Fassung BGBl II Nr. 49/2004

[157] Regulated in § 76 Abs. 7 AWG 2002

[158] as defined at the beginning of this sub-chapter

[159] Electronic Data Management

[160] According to § 41 (1) Landfill Ordinance, Federal Gazette BGBl. Nr 39/2008

[161] According to §41 (1) Landfill Ordinance, Federal Gazette BGBl. Nr 39/2008

In the national study (HACKL & MAUSCHITZ 1999) as well as in the Federal Waste Management Plans the amounts of residual waste from administrative facilities of businesses and industries were not considered and therefore originally not included in the data of the years 1950 to 1999. Waste from these sources is however deposited and hence reported by the operators of landfill sites (therefore included in the Austrian landfill database) and thus considered in the time series from 1998 onwards. To achieve a consistent time series, data of the two overlapping years[162] (1998 and 1999) were examined and the difference – which represents the residual waste from administrative facilities of industries and businesses – was calculated. This difference, relative to the change of residual waste from households, was then applied to the years 1950 to 1997 accordingly.

The quantities of "non residual waste" from 1998 to 2007 were taken from the database for solid waste disposal "Deponiedatenbank" ("Austrian landfill database"), the values for 2008 onwards were taken from the EDM[163] (Electronic Data Management). Only the amounts of waste with biodegradable lots were considered. Table 282 presents a summary of all considered waste types and the corresponding numbers (list of waste). For calculating the emissions of residual waste the waste types were aggregated to the categories wood, paper, sludge, other waste, bio waste, textiles, construction waste and fats. There are no data available for the years before 1998. Thus extrapolation was done using the Austrian GDP (gross domestic product) per inhabitant (KAUSEL 1998) as indicator using a 20 year average value in order to get a more robust estimate.

Table 282: Considered types of waste (list of waste[164]).

Waste Identification No	Type of Waste	Waste Identification No	Type of Waste
0303	wastes from pulp, paper and cardboard production and processing	170204	Glass, plastic and wood containing or contaminated with dangerous substances
1905	wastes from aerobic treatment of solid waste	170903	other construction and demolition wastes (including mixed wastes) containing dangerous substances
1908	wastes from wastewater treatment plants not otherwise specified	170904	mixed construction and demolition waste
1909	wastes from the preparation of water intended for human consumption or water for industrial use	190805	sludge from treatment of urban wastewater
1912	wastes from the mechanical treatment of waste (for example sorting. crushing. compacting. pelletising) not otherwise specified	190809	grease and oil mixture from oil/water separation containing only edible oil and fats
20303	waste from solvent extraction	200101/ 200102	paper and cardboard
30105	Sawdust, shavings, cuttings, wood, particle board and veneer	200108	biodegradable kitchen and canteen waste
30304	de-inking sludge from paper recycling	200111	textiles

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[162] Data available from the Federal Waste Management Plan (Bundesabfallwirtschaftsplan - BAWP) as well as from the Austrian landfill database.

[163] Electronic Data Management (EDM): part of the eGovernment-strategy of the Austrian Government, registration requirements and reports in the field of environment.
https://secure.umweltbundesamt.at/edm_portal/home.do?wfjs_enabled=true&wfjs_orig_req=/home.do

[164] Commission Decision of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste.

Waste Identification No	Type of Waste	Waste Identification No	Type of Waste
30307	mechanically separated rejects from pulping of waste paper and cardboard	200201	Bio-degradable wastes
30310	fibre rejects, fibre-, filler-. and coating sludge from mechanical separation	200302	waste from markets
40106	Sludge, in particular from on-site effluent treatment containing chromium	200307	bulky waste
40109	waste from dressing and finishing	190811–14	sludge from treatment of industrial wastewater
40221	wastes from unprocessed textile fibres	200125	edible oil and fat
150103	wooden packaging	170201	wood

Methodology

Where available, country specific factors are used. If these were not available IPCC default values are taken. Table 283 summarises the parameters used and the corresponding references.

Table 283: Parameters for calculating methane emissions from SWDS.

Waste category/ Parameters	**residual waste**	**wood**	**paper**	**sludges**	**Sorting residues/ output MBT[165]/ bulky waste**	**Bio-waste**	**textiles**	**Construction waste**	**fats**
Methane correction factor	1 IPCC default for managed SWDS								
Fraction of degradable organic carbon dissimilated DOC_F	0.6	0.5	0.55	0.55	0.55	0.55	0.55	0.55	0.77
	IPCC default taking into account national waste expertises.								
DOC	see Table 285	0.45	0.3	0.11	0.16	0.16	0.5	0.09	0.2
	(Hackl & Mauschitz 1999) (Umweltbundesamt 2003) (BAWP 2006a)	(Baumeler et al. 1998)							
L_0 1)	see Table 285	0.165	0.121	0.444	0.065	0.064	0.202	0.034	0.113
Half life period	7	25	15	7	20	10	15	20	4
	National waste experts	(Gilberg et al. 2005)	(Gilberg et al. 2005)	Assumption: same as residual waste	IPCC default slow decay	Assumption: similar to paper	Assumption: same as paper	IPCC default slow decay	(Gilberg et al. 2005)
Number of considered years 2)	41	61	61	41	61	50	61	61	41
Fraction of CH_4 in Landfill Gas	0.55 Mean value cited in the literature, also within the IPCC range.								
Methane Oxidation in the upper layer	10% IPCC default								
Landfill gas recovery	see Figure 32 (Umweltbundesamt 2004e, 2008c)								

1) *L_0 is calculated for each waste category using the following equation and taking into account waste type specific parameters: L_0 = [MCF (x) * DOC (x) * DOC_F * F * 16/12 (Gg CH_4/Gg waste)]*

2) *In general historical data since 1950 are taken into account in the calculation. The number of considered years in a particular year however depends on the respective waste fraction respectively its half life period. To be in line with the base year calculation considering waste amounts for 1950-1990 the minimum number of years accounted for is 41 (to ensure time series consistency).*

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[165] MBT: **M**echanical-**b**iological **t**reatment

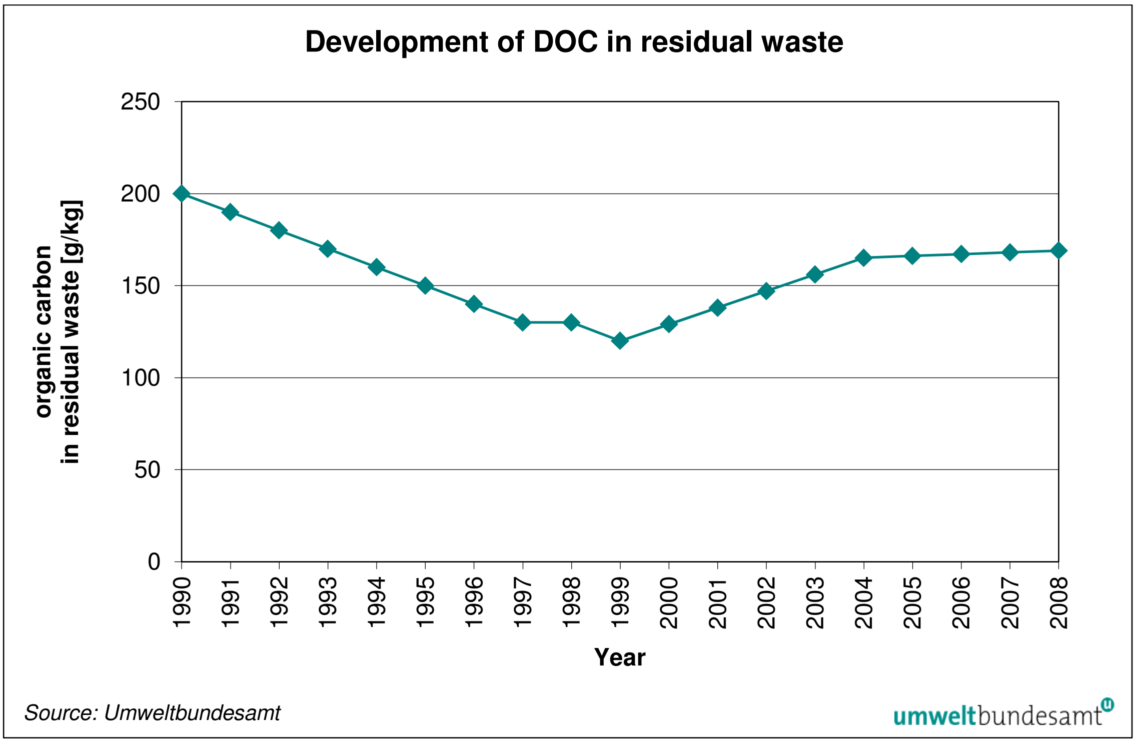
DOC

The DOCs of the different waste categories under '**non residual waste'** are constant for the entire time series and are shown in Table 283. As these categories are clearly defined (wood, paper, sludge, etc.) and can therefore be considered as quite 'homogenous', there was no need to change the DOC over the years.

The DOC of **residual waste** has changed over the years in accordance with the changing composition.

For the year 1990 a DOC content of 200 g/kg residual waste was taken (UMWELTBUNDESAMT 2003)[166]. In 1999 the DOC was determined to be 120 g/kg; it was calculated on the basis of information on the waste composition – i.e. the mixture of different waste fractions in residual waste deposited – and the carbon contents of the relevant fractions, based on literature on direct waste analysis (UMWELTBUNDESAMT 2003).

The DOC values for the years 2004 and 2008 were calculated in the course of the inventory preparation on basis of updated information on the composition of residual waste published in the Federal Waste Management Plan 2006 (BMLFUW 2006a) and its annual update 2009 (Status Report to the Federal Waste Management Plan 2006), taking into account the different carbon content of the fractions as published in (UMWELTBUNDESAMT 2003). The DOC for the years 2000–2003 and 2005–2007 are interpolated values. Since 2009 no residual waste is allowed to be deposited anymore.



Source: Umweltbundesamt

Figure 31: Development of DOC in residual waste.

The decrease during the 1990ies in DOC-content was due to the introduction of separate collection of bioorganic waste and paper waste. The amount of bio-waste that is collected separately increased over the time, while the organic share in residual waste decreased. This resulted in a

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[166] The values for the years before were taken from another national study (HACKL & MAUSCHITZ 1999).

change of waste composition with the effect of a decreasing DOC content. Since 2000 biogenic components in residual waste are increasing; this is due to the increasing share of biogenic components in residual waste.

Table 284 presents the composition of residual waste for several years between 1990 and 2004. On the basis of this information a time series for DOC was estimated (see Table 285). For the years before 1990, quantities according to a national study (HACKL & MAUSCHITZ 1999) were used.

Table 284: Composition of residual waste (ROLLAND & SCHEIBENGRAF 2003), (BMLFUW 2006a)

Residual waste	**1990¹⁾**	**1996¹⁾**	**1999¹⁾**	**2004²⁾**	**2008³⁾**
	[% of moist mass]	**[% of moist mass]**	**[% of moist mass]**	**[% of moist mass]**	**[% of moist mass]**
Paper, cardboard	21.9	13.5	14	11	12
Glass	7.8	4.4	3	5	4
Metal	5.2	4.5	4.6	3	3
Plastic	9.8	10.6	15	10	10
Composite materials	11.3	13.8	–	8	10
Textiles	3.3	4.1	4.2	6	6
Hygiene materials	–	–	12	11	8
Biogenic components	29.8	29.7	17.8	37	40
Hazardous household waste	1.4	0.9	0.3	2	1
Mineral components	7.2	3.8	–	4	3
Wood, leather, rubber, other components	2.3	1.1	2.6	1	–
Residual fraction	–	13.6	26.5	2	2

1) *(UMWELTBUNDESAMT 2003)*

2) *(BMLFUW 2006a)*

3) *Annual update (2009) of the Federal Waste Management Plan (BMLFUW 2006a)*

Table 285: Time series of bio-degradable organic carbon content and L_0 of residual waste

Year	bio-degradable organic carbon [g/kg Waste (moist mass)]	L_0	Year	bio-degradable organic carbon [g/kg Waste (moist mass)]	L_0
1950–1959	240 1)	0.106	1998	130 2)	0.057
1960–1969	230 1)	0.101	1999	120 2)	0.053
1970–1979	220 1)	0.097	2000	129 *)	0.057
1980–1989	210 1)	0.092	2001	138 *)	0.061
1990	200 2)	0.088	2002	147 *)	0.065
1991	190 2)	0.084	2003	156 *)	0.069
1992	180 2)	0.079	2004	165 3)	0.073
1993	170 2)	0.075	2005	166 *)	0.073
1994	160 2)	0.070	2006	167 *)	0.074
1995	150 2)	0.066	2007	168 *)	0.074
1996	140 2)	0.062	2008	169 4)	0.074
1997	130 2)	0.057	2009-2011	n.r.**)	n.r.

1) *(HACKL & MAUSCHITZ 1999)*

2) *(UMWELTBUNDESAMT 2003)*

3) *calculated according to waste composition 2001 (BMLFUW 2006a)*

4) *calculated according to waste composition 2009 (Status Report to BMLFUW 2006a)*

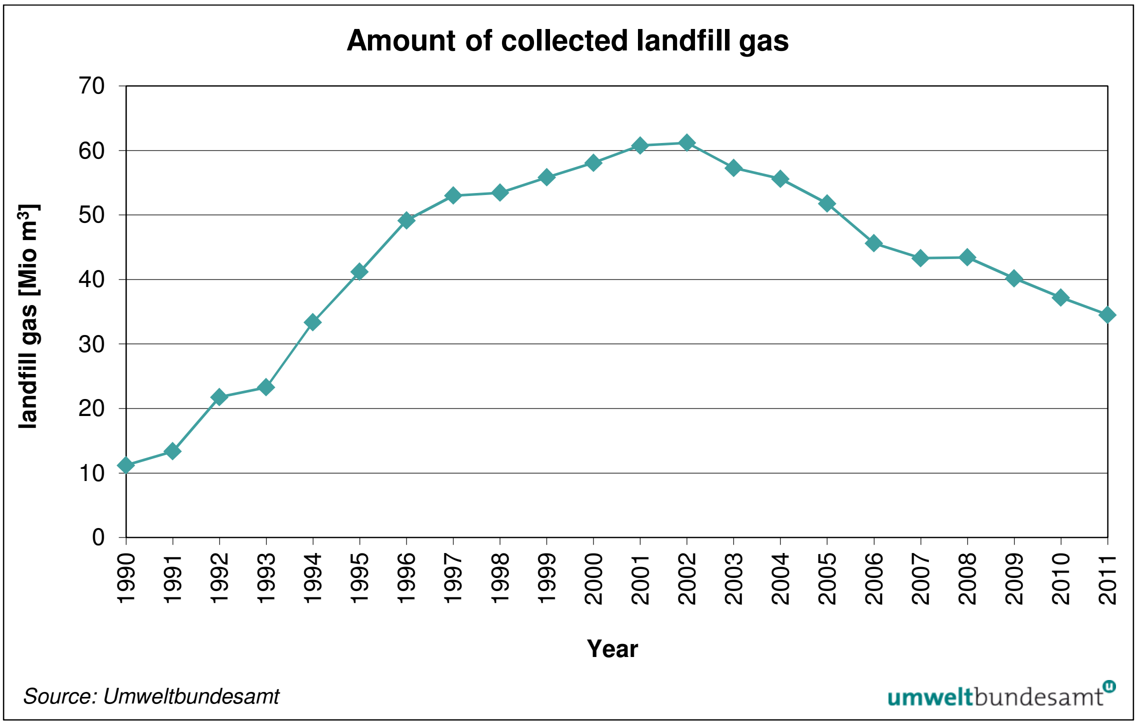
*) *interpolated values (2000-2003) and (2005-2007)*

***) not relevant*

Landfill gas recovery

In 2004, the Umweltbundesamt investigated the amount of annually collected landfill gas by questionnaires sent to landfill operators (UMWELTBUNDESAMT 2004e), showing that in 2001, the amount of collected landfill gas was more than 5 times higher than in 1990. In 1990 only 9 landfills were equipped with landfill gas wells. In 2001 at all operating mass landfills landfill gas was collected.

In 2008 a further study was conducted (UMWELTBUNDESAMT 2008a) again sending questionnaires to landfill operators to get new data on collected landfill gas as well as information on its use. Results show, that from 2002 on the amount of landfill gas generated – and landfill gas recovered accordingly – decreased as a consequence of the reduced carbon content of deposited waste (despite a consistent recovery practice).



Source: Umweltbundesamt

Figure 32: Amount of collected landfill gas 1990 to 2011 (UMWELTBUNDESAMT 2004c, UMWELBUNDESAMT 2008a).

The study from 2008 covers data for the years 2002–2007. As no new information on the amount of landfill gas recovered became available for the years 2008 to 2010, the mean value of the recovery rate of the years 2002 to 2007 (ranging from 12% to 14%) was taken as a proxy (13.2%) to calculate the actual amount of landfill gas recovered.

Moreover, the changing methane concentration in recovered landfill gas – decreasing from 48% (2002) to 45% (2007) (UMWELTBUNDESAMT 2008c) – has been considered in the calculation, resulting in less methane recovered and higher methane emitted accordingly. This is mainly due to the extensive capturing of landfill gas and the dilution of the landfill gas captured. For the years 2008-2011 the same methane concentration as 2007 can be assumed.

Emission Factors

NMVOC, CO, NH_3 and heavy metal emissions are calculated according to their content in the emitted landfill-gases (after consideration of gas recovery). [167]

Table 286: Emission factors for CO, NMVOC, NH_3 and heavy metals.

	CO	NMVOC	NH_3	Cd	Hg	Pb
	Vol.%	**Vol.%**	**Vol.%**	**mg/Nm³**	**mg/Nm³**	**mg/Nm³**
concentration in landfill gas	2	300	10	0.003	0.00002	0.003

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[167] according to UMWELTBUNDESAMT (2001b)

PM emissions are calculated according to WINIWARTER et al. 2007, only with regard to the relevant waste types (where particular matter emissions from handling can be expected). It is assumed that PM10 is 47% of TSP and PM2.5 is 15% of TSP.

Table 287: Emission factors for PM.

TSP	**PM10**	**PM2.5**
g/Mg WASTE	**g/Mg WASTE**	**g/Mg WASTE**
18.00	8.52	2.68

Recalculations

An update of activity data, i.e. waste amounts deposited in 2010, has resulted in a minor recalculation (downwards) of all relevant gases.

7.4 NFR 6 C Waste Incineration

Source Description

In this category emissions are included from

- incineration of corpses,
- hospital waste,
- waste oil,
- incineration of domestic or municipal solid waste without energy recovery.

Additionally heavy metal and POPs emissions of a single plant without emission control 1990 to 1991 are included here. From 1992 the plant was equiped with ESP. Emissions 1992 to 2000 are included in category 1 A 4 a and from 2001 on in category 1 A 1 a. Emissions from incineration of carcasses are not estimated. Waste incineration plants are allocated to category 1 A 4 a if heat is recovered for own usage but not used for generation of public electricity or heat.

In Austria waste oil is incinerated in especially designed so called "USK-facilities". The emissions of waste oil combustion for energy use (e.g. in cement industry) are reported under NFR sector 1 A Fuel Combustion.

In general, municipal, industrial and hazardous waste are combusted in district heating plants or in industrial sites and the energy is used. Therefore their emissions are reported in NFR category 1 A Fuel Combustion. There is only one waste incineration plant which has been operated until 1991 with a capacity of 22 000 tons of waste per year without energy recovery and emission controls. This plant has been rebuilt as a district heating plant starting operation in 1996. Therefore the emissions of this plant are reported under NFR category 1 A Fuel Combustion from 1996 onwards.

Small scale waste burning

Emissions from wood waste are considered in categories 4 F and 4 G. It is assumed that other (illegal) small scale residential combustion occurs in heatings or stoves (included in category 1 A 4). Especially when considering POPs emissions from this source the national emission factors consider this issue due to the fact that POP emission factors are derived from field measurements which consider the "memory effect" of illegal waste co-incineration. Residential biomass heatings are widely used in Austria and wood use is based on a bootom up model by using household cenus data. It is assumed that illegal waste incineration just replaces other solid fuels and therefore other pollutants such as TSP, heavy metals and NO_X from wood waste are also expected to be included in category 1 A 4.

Methodology

The simple CORINAIR methodology is used. Emission factors are specific to type of waste and combustion techology.

Activity data

For municipal solid waste the capacity (22 000 tons of waste per year) of one operating waste incineration plant without energy recovery was used.

Waste oil activity data 1990 to 1999 were taken from (UMWELTBUNDESAMT 1995). For 2000 to 2005 the activity data of 1999 was used. (UMWELTBUNDESAMT 2001b) quotes that in 2001 total waste oil accumulation was about 37 500 t. Nevertheless, waste oil is mainly used for energy recovery in cement kilns or public power plants and it is consequently accounted for in the energy balance as *Industrial Waste*.

Activity data of clinical waste is determined by data interpretation of the waste flow database at the *Umweltbundesamt* considering the waste key number "971" ("Abfälle aus dem medizinischen Bereich") for the years 1990 and 1994 and extrapolated for the remaining time series.

Since 2005 the Austrian waste incineration regulation gives strong limits for air pollution for all kind of waste incineration without any limit of quantity. Since then all operators which do have an allowance for incineration of a specific type of waste needs to be registered in a federal database. The number of waste incineration plants which are not considered under sector 1.A is:

- Waste oil: 8,
- Clinical waste: 1,
- Municipal solid waste: None.

The average yearly quantity of each waste incineration plant has been estimated as 500 t for hazardous clinical waste (plastics only). For waste oil the maximum USK facility capacity of 60.8 t per year (UMWELTBUNDESAMT 2001b) has been selected as activity data for 2011. Activity data for the years 2006–2011 has been interpolated.

Table 288: Activity data for IPCC Category 6 C Waste Incineration.

Year	Municipal Waste [Mg]	Clinical Waste [Mg]	Waste Oil [Mg]
1990	22 000	9 000	2 200
1991	22 000	7 525	1 500
1992	0	6 050	1 800
1993	0	4 575	2 100
1994	0	3 100	2 500
1995	0	3 100	2 600
1996	0	3 100	2 700
1997	0	3 100	2 800
1998	0	3 100	2 900
1999–2005	0	3 100	3 000
2006	0	2 500	2 500
2007	0	2 000	2 000
2008	0	1 500	1 500
2009	0	1 000	1 000
2010	0	500	500
2011	0	500	500

Emission factors

Heavy metal emission factors are taken from (HÜBNER 2001a). POPs emission factors are taken from (HÜBNER 2001b). Main pollutant emission factors: For municipal waste the industrial waste emissions factors from (BMWA 1990) are taken and converted by means of a NCV of 8.7 TJ/kt. Waste oil emission factors are selected similar to uncontrolled industrial residual fuel oil boilers. Clinical waste emission factors selected by means of industrial waste emissions factors from (BMWA 1990). Table 289 shows emission factors of the air pollutants.

Table 289: NFR 6 C Waste Incineration: emission factors by type of waste.

Type of waste	NO_x	CO	NMVOC	SO_2	NH_3
			[kg/kt]		
Waste oil	8 060.0	604.5	403.0	18 135.0	110.0
Municipal waste	870.0	1 740.0	330.6	1 131.0	0.2
Clinical waste	7 000.0	840.0	330.0	700.0	0.2

Municipal waste	Cd	Hg	Pb	PAH	DIOX	HCB
			[kg/kt]			
1985	2 580.0	1 800.0	30 000.0	0.7	250.0	850.0
1986	2 078.2	1 499.8	24 234.0	0.7	250.0	850.0
1987	1 576.4	1 199.6	18 468.0	0.7	250.0	850.0
1988	1 074.6	899.4	12 702.0	0.7	250.0	850.0
1989	572.8	599.2	6 936.0	0.7	250.0	850.0
1990	71.0	299.0	1 170.0	0.7	250.0	850.0
1991	59.2	263.2	966.0	0.7	250.0	850.0

Industrial Waste	**Cd**	**Hg**	**Pb**	**PAH**	**DIOX**	**HCB**
				[kg/kt]		
1985	720.0	100.0	8 300.0	1.6	160.0	970.0
1986	678.0	102.4	7 120.0	1.6	160.0	970.0
1987	636.0	104.8	5 940.0	1.6	160.0	970.0
1988	594.0	107.2	4 760.0	1.6	160.0	970.0
1989	552.0	109.6	3 580.0	1.6	160.0	970.0
1990	510.0	112.0	2 400.0	1.6	160.0	970.0
1991	414.0	99.4	1 922.0	1.6	160.0	970.0

sludges from waste water treatment	**Cd**	**Hg**	**Pb**	**PAH**	**DIOX**	**HCB**
				[kg/kt]		
1985	6.0	3.0	280.0	1.6	1.5	300.0
1986	51.8	13.4	370.0	1.6	1.5	300.0
1987	97.6	23.8	460.0	1.6	1.5	300.0
1988	143.4	34.2	550.0	1.6	1.5	300.0
1989	189.2	44.6	640.0	1.6	1.5	300.0
1990	235.0	55.0	730.0	1.6	1.5	300.0
1991	191.8	45.8	585.2	1.6	1.5	300.0

Clinical waste	**Cd**	**Hg**	**Pb**	**PAH**	**DIOX**	**HCB**
				[kg/kt]		
1985–1990	4.77	5.76	540.00	0.00	1.08	216.00
1991	3.99	4.82	451.50	0.00	0.68	135.45
1992	3.21	3.87	363.00	0.00	0.36	72.60
1993	2.42	2.93	274.50	0.00	0.14	27.45
1994	1.64	1.98	186.00	0.00	0.00	0.19
1995–2005	0.62	0.71	7.75	0.00	0.00	0.19
2006	0.50	0.58	6.25	0.00	0.00	0.16
2007	0.40	0.46	5.00	0.00	0.00	0.12
2008	0.30	0.35	3.75	0.00	0.00	0.09
2009	0.20	0.23	2.50	0.00	0.00	0.06
2010	0.10	0.12	1.25	0.00	0.00	0.03
2011	0.10	0.12	1.25	0.00	0.00	0.03

Waste oil	Cd	Hg	Pb	PAH	DIOX	HCB
	[kg/kt]					
1985	1 800.0	150.0	200 000.0	6.7	37.0	37 000.0
1986	1 512.0	126.0	181 260.0		37.0	37 000.0
1987	1 224.0	102.0	162 520.0		37.0	37 000.0
1988	936.0	78.0	143 780.0		35.6	35 591.2
1989	648.0	54.0	125 040.0		31.9	31 947.6
1990	360.0	30.0	106 300.0		17.0	17 020.0
1991			87 560.0		0.4	370.0
1992			68 820.0			
1993			50 080.0			
1994			31 340.0			
1995–2011	13.0		60.0			

Table 290: *NFR 6 C Waste Incineration of corps: emission factors.*

Hg	Pb	PAH	Dioxin	HCB
[kg/kt]		[kg/kt]	[mg/corps]	[µg/corps]
3 000(4)	0.02(1)	0.40(1)	16.60(2)	3 320(2)
2 500(5)			8.30(3)	1 660(3)
2 500(6)				
1 000(7)				

(1) *for 1985–2008*

(2) *for 1980–1992*

(3) *for 1993–2008*

(4) *for 1985–1990*

(5) *for 1991*

(6) *for 1992–1995*

(7) *for 2000–2011*

7.4.1 Recalculations

No recalculations have been made in this years' submission.

7.5 NFR 6 D Other Waste

Source Category Description

In this category NH_3 emissions from mechanical-biological treatment and composting of waste is addressed. NH_3 emissions arising from this subcategory increased over the time period as a result of the increasing amount of biologically treated waste.

Methodological Issues

Emissions were estimated using a simple methodology following the IPCC 2006 GL for GHG Inventories. Two different fractions were considered:

- waste from households and similar sources covered by the municipal waste collecting system, undergoing a bio-technical treatment (treatment in Mechanical-Biological Treatment (MBT) plants). To a smaller extent also waste from industrial sources (for ex. residues from processing of recovered paper) are included (UMWELTBUNDESAMT 2008d).
- biogenic waste composted, which in turn comprises green/bio waste collected and treated in composting plants[168] (centralised composting) and bio waste composted at the place it is generated (home composting).

NH_3 emissions were calculated by multiplying an emission factor with the quantity of waste.

$NH_3\ Emissions = M_i * Ef_i$

Where:

M_i *mass of organic waste treated by biological treatment type i (composting, MBT)*
EF_i *emission factor for treatment i (MBT, composting)*

Activity data

Since 2006, most of data required is available from a national publication referred to as 'Federal Waste Management Plan' (Bundesabfallwirtschaftsplan), which is (in part) updated annually ('Status Reports').

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[168] A certain part of this waste undergoes an anaerobic treatment (digestion), but currently all bio waste generated is assumed to be treated aerobically (composted).

Table 291: Activity data for NFR Category 6.D Other Waste.

	Total waste	Mechanical-biological waste treatment (MBT)		Bio waste collected separately		Loppings; gardening waste		Home composting	
	[Gg]	[Mg]	source	[Mg]	source	[Mg]	source	[Mg]	source
1990	763	345 000	Baumeler et al. 1998	10 436	sum of data reported by the Austrian Federal Provinces, (Amlinger 2003)	37 370	sum of data reported by the Austrian Federal Provinces, (Amlinger 2003)	370 000	Amlinger 2003
1991	798	345 000		27 372		50 995		375 000	
1992	942	345 000		88 243		48 464		460 000	
1993	1 161	345 000		156 936		149 470		510 000	
1994	1 373	345 000		246 375		197 130		584 985	
1995	1 446	294 739	Angerer 1997	301 809		249 264		600 000	
1996	1 515	281 378	expert judgement	334 371		283 127		616 000	
1997	1 488	243 780	Lahl 1998	351 862		229 643		662 571	
1998	1 541	239 671	Lahl 2000	362 572		241 835		696 487	
1999	1 621	265 672	Umweltbundesamt 2001e	378 796		244 587		732 273	
2000	1 703	253 660	inter-polated	374 271		303 239	interpolated	771 773	
2001	1 928	241 648		399 090		361 890		944 412	inter-polated
2002	2 150	229 636		422 126		420 542		1 117 051	
2003	2 362	217 625	Umweltbundesamt 2008d	433 911		479 194		1 289 691	
2004	2 979	487 623		491 670	BAWP (Bmlfuw 2006a)	537 845		1 462 330	calculated on basis of Status Report 2008**
2005	3 236	623 393		543 420	inter-polated	596 497		1 472 325	
2006	3 391	660 231		595 170	Status Report* 2007	655 148		1 479 963	
2007	3 503	684 322		618 570	Status Report* 2008	713 800	Status Report* 2008	1 485 871	Status Report* 2008
2008	3 470	619 495	inter-polated	650 700	Status Report* 2009	699 400	Status Report* 2009	1 500 579	calculated on basis of Status Report 2008**
2009	3 489	554 668	BAWP (Bmlfuw 2011)	752 100	BAWP (Bmlfuw 2011)	677 400	BAWP (Bmlfuw 2011)	1 505 000	BAWP (Bmlfuw 2011)
2010	3 543	601 273	based on EDM reports***)	754 897	calculated on basis of BAWP (Bmlfuw 2011)	677 400	same as 2009	1 509 794	calculated on basis of BAWP (Bmlfuw 2011)**
2011	3 552	601 273	same as 2010	757 881		677 400		1 515 762	

*) *Status Reports: annual updates (2007, 2008, 2009) of the Federal Waste Management Plan 2006 (**B**undes**A**bfall**W**irtschafts**P**lan - Bmlfuw 2006a)*

**) *In Status Report 2008 and BAWP 2011 (Bmlfuw 2011) a value of the amount of home composted waste (in kg) per capita is given. This factor was used to calculate the emissions for the years 2004-2006 and 2010-2011 too.*

****) interim evaluation of activity data (input MBT) reported via EDM portal by facilities; conducted for status report 2012.*

Emission factors

Due to different emission factors in different national references an average value was used for each of the two fractions of bio-technically treated waste.

Table 292: Emission factors for IPCC Category 6 D Other Waste (Compost Production).

	NH_3 [kg/t FS]	References
Mechanical-biologically treated waste	0.6	(UMWELTBUNDESAMT BERLIN 1999) (AMLINGER ET AL. 2003, 2005) (ANGERER & FRÖHLICH 2002) (DOEDENS ET AL. 1999)
Composted waste (bio-waste, lopping, home composting)	0.4	(AMLINGER et al. 2003, 2005)

7.5.1 Recalculations

The recalculation of the year 2010 (+0.09 Gg NH_3 respectively +6.8%) is due to updated data on waste amounts treated in mechanical-biological treatment plants, delivered by the EDM (Electronic Data Management).

7.6 Recalculations

Recalculations have been made for sub categories *6.A Solid Waste Disposal* and *6.D Other*. Explanations are provided in the respective subchapters.

8 RECALCULATIONS AND IMPROVEMENTS

8.1 Relation to data reported earlier

As a result of the continuous improvement of Austria's National Air Emission Inventory, emissions of some sources have been recalculated based on updated data or revised methodologies, thus emission data for 1990 to 2011 submitted this year might differ from data reported previously.

The last in-depth review (stage 3) took place in 2010; findings were commented in the IIR 2011 (UMWELTBUNDESAMT 2011f). The last in-depth review (stage 1 and 2) took place in 2012.

The figures presented in this report replace data reported earlier by the Umweltbundesamt under the reporting framework of the UNECE/LRTAP Convention and NEC Directive of the European Union.

8.2 Explanations and Justifications for Recalculations

Explanations for recalculations per sector are given in the respective chapters, tables and figures indicating the recalculations can be found in the chapter 8.3.

Compiling an emission inventory includes data collecting, data transfer and data processing. Data has to be collected from different sources, for instance

- national statistics,
- associations,
- plant operators,
- studies,
- personal information,
- other publications.

The provided data must be transferred from different data formats and units into a unique electronic format to be processed further. The calculation of emissions by applying methodologies on the collected data and the final computing of time series into a predefined format (NFR) are further steps in the preparation of the final submission. Finally the submission must be delivered in due time. Even though a QA/QC system gives assistance so that potential error sources are minimized it is necessary to make some revisions – so called recalculations – under the following circumstances:

- An emission source was not considered in the previous inventory.
- A source/data supplier has delivered new data because previous data were preliminary data only (by estimation, extrapolation) or the methodology has been improved.
- Occurrence of errors in data transfer or processing: wrong data, unit-conversion, software errors, et al.
- Methodological changes: a new methodology must be applied to fulfil the reporting requirements because one of the following reasons:
  - to decrease uncertainties;
  - an emission source becomes a key source;
  - consistent input data needed for applying the methodology is no longer accessible;
  - input data for more detailed methodology is now available;
  - methodology is no longer appropriate..

The following section describes the methodological changes made to the inventory since the previous submission (for each sector).

ENERGY (1 A)

Update of activity data

Main revisions of the energy balance

The main revisions affected the years 2009 and 2010 and minor revisions have been carried out for the year 2005. Solid biomass for power plants (1 A 1 a) was revised upwards by about 8 PJ and for wood processing industries (1 A 2 f) by about 4 PJ for the year 2010. For the years 2009 and 2010 about 3 to 4 PJ of natural gas from power plants, for the year 2010 about 3 PJ from other energy industries (1 A 1 c) and for the years 2009 to 2010 about 4 to 6 PJ of natural gas have been shifted to the subsector other sectors (1 A 4). Consumption by waste incineration plants (1 A 1 a) was revised upwards by about 1.6 PJ for the years 2009 and 2010.

Improvements of methodologies and emission factors:

Road Transport (1 A 3 b)

The inventory data and specific consumption data on passenger cars have been updated with current values derived from CO_2 monitoring[169] of the new car fleet. This has caused a slight change in specific consumption compared to last year's inventory.

Because of updates due to changes in the time series of the national energy balance the levels for liquid gas, natural gas and biogas changed retrospectively. The years concerned are especially between 2000 and 2003 and 2009[170].

An update of emission factors resulted in a number of single effects:[171]

- Passenger cars: As opposed to the original prognosis, namely that NO_X emissions from EURO 5 diesel engines would be roughly the same as with EURO 4, measurements[25] of the Technical University Graz conducted in 2012 showed that NO_x emission factors for EURO 5 diesel passenger cars had to be revised upwards. Depending on the traffic situation, the level of emissions with EURO 5 is currently 13 % - 27 % above EURO 4. Although emissions from EURO 6 diesel passenger cars are clearly below EURO 5, they are still above the levels originally predicted.
- Light duty vehicles: No measurement data are available on light duty vehicles. Therefore the rates of change in relation to EURO 4 were the same as those assumed for passenger cars.
- Heavy duty vehicles: The measurements of EURO 5 heavy duty vehicles which had been available since the last update of emission factors made a 44 % increase of NO_x emission factors necessary. By contrast, measurements of EURO 6 heavy duty vehicles carried out and used in the inventory up to now showed lower emission levels than expected (- 36 % compared to previous emission factors for EURO 6).

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[169] Lebensministerium (2012): CO_2 Monitoring 2011. Zusammenfassung der Daten der Neuzulassungen von Pkw der Republik Österreich gemäß Entscheidung Nr. 1753/2000/EG für das Berichtsjahr 2011. Wien, 2012.

[170] HAUSBERGER, S. / SCHWINGSHACKL, M. (2012): Straßenverkehrsemissionen und Emissionen sonstiger mobiler Quellen Österreichs für die Jahre 1990 bis 2011; erstellt im Auftrag der Umweltbundesamt GmbH, Graz, 2012.

[171] HAUSBERGER, S. / REXEIS, M. (2012): Update der Emissionsfaktoren für die Luftschadstoffinventur; erstellt im Auftrag der Umweltbundesamt GmbH, Graz, 2012.

These updates overall resulted in a 4.5 % increase in NO_X emissions from road transportation in 2010 compared to the previous submission (calculated on the basis of fuel used).

Current trends:

From 2010 until 2011 national fuel consumption by road transport (gasoline, diesel and alternative fuels) declined by about 3 %, a decrease which was mainly due to increased fuel prices. Specific consumption per vehicle kilometre also declined between 2010 and 2011.

Specific NO_x emissions per vehicle kilometre also declined. An average passenger car, emitting about 0.48 g NO_x/km in 2010, emitted about 0.47 g in 2011 (heavy duty vehicles 6.0 g NO_x/km 2010; 5.6 g NO_x/km 2011).

Renewal of the fleet also has an effect on NO_x reductions. This can be observed when looking at the 2009-2011 period: NO_x emissions from national road transport went down (by about 6 %) between 2009 and 2011 while transport fuel sales were down by only about 0.5 %. Fleet renewal is thus more important for such observations than an increase of emission factors by updates.

NO_x emissions from national road transport (without 'fuel exports') went down by 2.8 % between 2010 and 2011 to about 65,000 tonnes.

Off-Road – Mobile Sources (1 A 2 f, 1 A 4 a,b,c)

With the introduction of emission level 4 (European emission standards for new non-road (off-road) engines) for off-road equipment for combustion >56 KW, an update of emission factors was carried out. The following emission factors were revised: tractors (agriculture, forestry), construction machinery (large and small machinery), wood chips, combine harvester, motorised carts, industry (small and large equipment), passenger ships, working boats, ski piste and cross-country track setting equipment.[172]

Because of the integration of new emission levels in the off-road sector a reallocation of mobile machinery and equipment according to size classes and emission levels was necessary. In total, there was – however - no noticeable increase in NO_x emissions.

1 A 4 Other sectors - stationary combustion

The results of the household census 2010[173] for different types of heating devices per energy source in households have been included.

1 B 1 a Coal Mining and Handling

NMVOC emissions from coal mining have been included in the 2012 Austrian air emission inventory. The emissions were calculated based on activity data available in national statistics and reports (e. g. a report on mining by the Federal Ministry of Economy, Family and Youth[174]) and the tier 2 emission factor for surface mines given in the EMEP/EEA air pollutant emission inventory guidebook[175]. The inclusion of NMVOC emissions from coal mining leads only to a

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[172] HAUSBERGER, S. / SCHWINGSHACKL, M. (2012): Straßenverkehrsemissionen und Emissionen sonstiger mobiler Quellen Österreichs für die Jahre 1990 bis 2011; erstellt im Auftrag der Umweltbundesamt GmbH, Graz, 2012.

[173] STATISTIK AUSTRIA (2012): Sonderauswertung des Mikrozensus 2010 (MZ 2010): Energieeinsatz der Haushalte. Statistik Austria im Auftrag des BMLFUW. Wien.

[174] Bundesministerium für Wirtschaft und Arbeit (2012): Österreichisches Montan-Handbuch 2012. Bergbau - Rohstoffe - Grundstoffe – Energie. Wien 2012.

[175] EMEP/EEA (2009): EMEP/EEA air pollutant emission inventory guidebook – 2009. Technical report No 9/2009. Copenhagen 2009.

minor increase in the national total and is only relevant for years in the past since coal mining stopped in Austria in 2007[176].

AGRICULTURE (4)

Update of activity data

4 B 6 Horses, 4 B 9 Poultry, 4 B 13 Other

Animal numbers of horses, poultry and other animals have been updated with new activity data from the 2010 Agricultural Structure Survey. This update resulted in an increase of 2010 emissions from other animals (furred game, mainly deer) and poultry (chicken and other poultry) and a decrease of 2010 emissions from horses (NH_3 and NO_X).

4 F Field Burning of Agricultural Waste

Activity data on viniculture areas has been updated for 2010, resulting in a slight decrease of NH_3, NO_X, NMVOC and SO_2 emissions.

Improvements of methodologies and emission factors

4 B Manure Management

In the Austrian QMS extensive QA and verification activities are carried out on a regular basis (Tier 2 QA). In 2012 the agriculture sector was validated. Some minor inconsistencies with respect to the AWMS data used in the THG inventory were found and corrected. This validation resulted in a deviation from previous sector 4 B NH_3 and NO_X emissions by < 0.2 %.

WASTE (6)

Update of activity data

6 A Solid waste disposal on land

An update of activity data (waste amounts deposited) for 2010 has resulted in a minor recalculation of NMVOC and NH_3 emissions.

6 D Other waste

NH_3 emissions for 2010 have been recalculated after an update of activity data on waste amounts treated in mechanical-biological treatment plants.

8.3 Recalculations per Gas

The following tables present the changes in emissions[177] for all relevant gases compared to the previous submission (IIR 2012). Detailed explanations are provided in the sectoral chapters.

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[176] BUNDESMINISTERIUM FÜR WIRTSCHAFT UND ARBEIT (2008): Österreichisches Montan-Handbuch 2008. Bergbau - Rohstoffe - Grundstoffe – Energie. Wien 2008.

[177] An equals sign "=" in the field for relative difference indicates that reported emissions do not differ from the previous submission; blank fields indicate that no such emissions occur from this sector;

Table 293: Recalculation difference of SO_2 emissions in general with respect to submission 2011.

		1990			2010			Absolute Diff.	
NFR SO_2 emissions		**Δ%**	**OLI 2011**	**OLI 2012**	**Δ%**	**OLI 2011**	**OLI 2012**	**1990**	**2010**
1 A 1	Energy Industries	=	14.04	14.04	*9.7%*	3.24	3.55	-	0.31
1 A 2	Manufacturing Industries & Construction	*<0.1%*	17.97	17.97	*-1.9%*	10.85	10.65	<0.01	-0.20
1 A 3	Transport	*<0.1%*	5.20	5.20	*-0.8%*	0.30	0.30	<0.01	<0.01
1 A 4	Other Sectors	*<0.1%*	32.94	32.94	*-0.5%*	2.90	2.88	<0.01	-0.02
1 A 5	Other	=	0.01	0.01	=	0.01	0.01	-	-
1 B	Fugitive Emissions	=	2.00	2.00	=	0.23	0.23	-	-
2	Industrial Processes	=	2.22	2.22	=	1.21	1.21	-	-
3	Solvent & Oth. Prod. Use	=	NA	NA	=	NA	NA	-	-
4	Agriculture	=	<0.01	<0.01	*-2.2%*	<0.01	<0.01	-	<0.01
6	Waste	=	0.07	0.07	=	0.01	0.01	-	-
Total	**Total Emissions**	*<0.1%*	74.45	74.45	*0.5%*	18.76	18.85	<0.01	0.09

Table 294: Recalculation difference of NO_x emissions in general with respect to submission 2011.

		1990			2010			Absolute Diff.	
NFR NO_x emissions		**Δ%**	**OLI 2011**	**OLI 2012**	**Δ%**	**OLI 2011**	**OLI 2012**	**1990**	**2010**
1 A 1	Energy Industries	=	17.74	17.74	*0.7%*	13.83	13.93	-	0.10
1 A 2	Manufacturing Industries & Construction	*<0.1%*	32.97	32.97	*1.1%*	31.81	32.16	<0.01	0.36
1 A 3	Transport	*<0.1%*	105.56	105.55	*3.3%*	113.10	116.86	-0.01	3.77
1 A 4	Other Sectors	*0.3%*	27.66	27.73	*0.6%*	22.89	23.03	0.07	0.14
1 A 5	Other	*<0.1%*	0.07	0.07	*-0.5%*	0.08	0.08	<0.01	<0.01
1 B	Fugitive Emissions	=	IE	IE	=	IE	IE	-	-
2	Industrial Processes	=	4.80	4.80	=	1.50	1.50	-	-
3	Solvent & Oth. Prod. Use	=	NA	NA	=	NA	NA	-	-
4	Agriculture	*0.1%*	6.51	6.51	*0.2%*	5.58	5.59	<0.01	0.01
6	Waste	=	0.10	0.10	=	0.01	0.01	-	-
Total	**Total Emissions**	*<0.1%*	195.41	195.47	*2.3%*	188.79	193.16	0.06	4.38

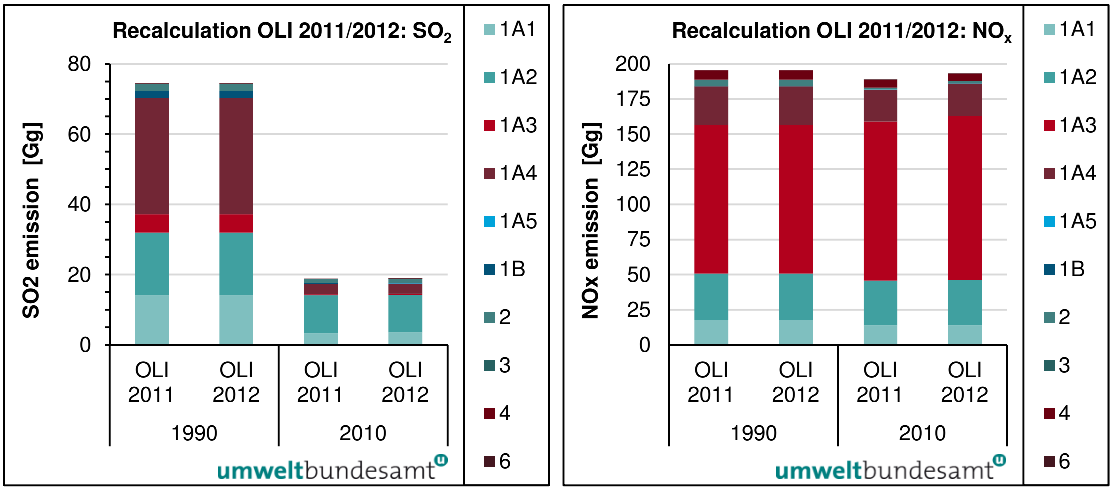

Figure 33: Recalculation difference of SO_2 and NO_x emissions with respect to submission 2011.

Table 295:Recalculation difference of NMVOC emissions in general with respect to submission 2011.

		1990			2010			Absolute Diff.	
NFR NMVOC emissions		**Δ%**	**OLI 2011**	**OLI 2012**	**Δ%**	**OLI 2011**	**OLI 2012**	**1990**	**2010**
1 A 1	Energy Industries	=	0.42	0.42	*12.2%*	0.80	0.89	-	0.10
1 A 2	Manufacturing Industries & Construction	*<0.1%*	1.74	1.74	*-0.2%*	2.40	2.40	<0.01	<0.01
1 A 3	Transport	*-3.6%*	72.87	70.23	*8.6%*	13.47	14.63	-2.63	1.16
1 A 4	Other Sectors	*<0.1%*	61.28	61.28	*0.5%*	33.57	33.72	<0.01	0.15
1 A 5	Other	*-0.1%*	0.01	0.01	*-0.2%*	0.02	0.02	<0.01	<0.01
1 B	Fugitive Emissions	*4.0%*	12.13	12.62	*1.2%*	1.98	2.00	0.49	0.02
2	Industrial Processes	=	11.10	11.10	*-0.8%*	4.73	4.69	-	-0.04
3	Solvent & Oth. Prod. Use	=	114.43	114.43	=	74.09	74.09	-	-
4	Agriculture	=	1.85	1.85	*-0.2%*	1.78	1.78	-	<0.01
6	Waste	=	0.16	0.16	*<0.1%*	0.06	0.06	-	<0.01
Total	**Total Emissions**	*-0.8%*	275.98	273.84	*1.0%*	132.89	134.28	-2.15	1.39

Table 296: Recalculation difference of NH_3 emissions in general with respect to submission 2011.

		1990			2010			Absolute Diff.	
NFR NH_3 emissions		**Δ%**	**OLI 2011**	**OLI 2012**	**Δ%**	**OLI 2011**	**OLI 2012**	**1990**	**2010**
1 A 1	Energy Industries	=	0.20	0.20	*8.7%*	0.46	0.50	-	0.04
1 A 2	Manufacturing Industries & Construction	*<0.1%*	0.35	0.35	*4.9%*	0.41	0.43	<0.01	0.02
1 A 3	Transport	*<0.1%*	2.88	2.88	*-2.3%*	1.28	1.25	<0.01	-0.03
1 A 4	Other Sectors	*<0.1%*	0.63	0.63	*1.4%*	0.68	0.69	<0.01	0.01
1 A 5	Other	=	<0.01	<0.01	*0.1%*	<0.01	<0.01	-	<0.01
1 B	Fugitive Emissions	=	IE	IE	=	IE	IE	-	-
2	Industrial Processes	=	0.27	0.27	=	0.09	0.09	-	-
3	Solvent & Oth. Prod. Use	=	NA	NA	=	NA	NA	-	-
4	Agriculture	*-0.2%*	60.80	60.70	*1.1%*	58.22	58.83	-0.09	0.61
6	Waste	=	0.36	0.36	*6.8%*	1.30	1.39	-	0.09
Total	**Total Emissions**	*-0.1%*	65.48	65.39	*1.2%*	62.45	63.19	-0.09	0.74

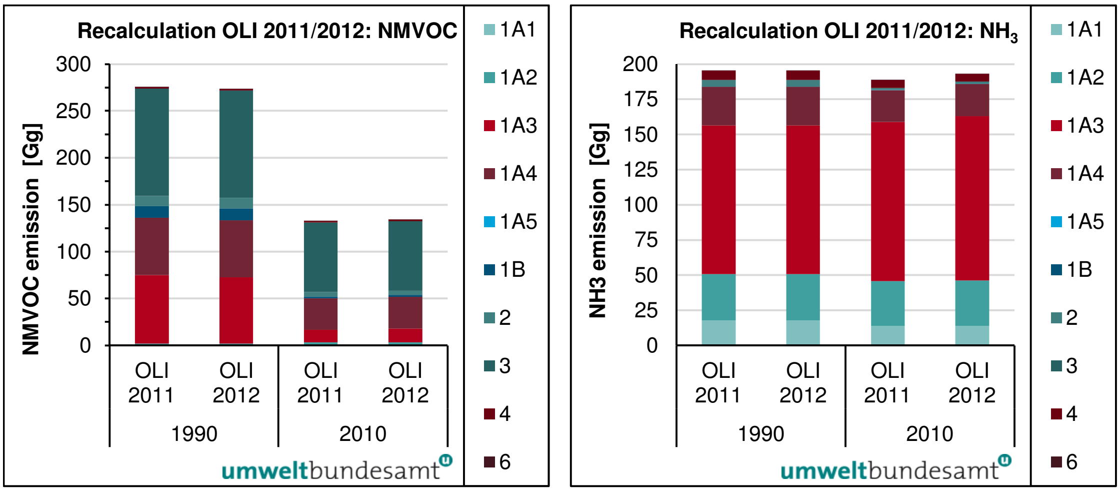

Figure 34: Recalculation difference of NMVOC and NH_3 emissions with respect to submission 2011.

Table 297: Recalculation difference of CO emissions in general with respect to submission 2011.

		1990			2010			Absolute Diff.	
NFR CO emissions		**Δ%**	**OLI 2011**	**OLI 2012**	**Δ%**	**OLI 2011**	**OLI 2012**	**1990**	**2010**
1 A 1	Energy Industries	*=*	6.07	6.07	*15.2%*	5.23	6.03	-	0.79
1 A 2	Manufacturing Industries & Construction	*<0.1%*	230.74	230.75	*0.2%*	138.30	138.58	<0.01	0.28
1 A 3	Transport	*<0.1%*	658.69	658.68	*-1.1%*	163.87	162.05	-0.01	-1.82
1 A 4	Other Sectors	*<0.1%*	482.20	482.16	*2.2%*	302.12	308.75	-0.04	6.63
1 A 5	Other	*<0.1%*	0.22	0.22	*-0.1%*	0.28	0.28	<0.01	<0.01
1 B	Fugitive Emissions	*=*	IE	IE	*=*	IE	IE	-	-
2	Industrial Processes	*=*	46.37	46.37	*=*	23.86	23.86	-	-
3	Solvent & Oth. Prod. Use	*=*	NA	NA	*=*	NA	NA	-	-
4	Agriculture	*=*	0.99	0.99	*-2.1%*	0.66	0.65	-	-0.01
6	Waste	*=*	11.16	11.16	*<0.1%*	4.54	4.54	-	<0.01
Total	**Total Emissions**	*<0.1%*	1 436.44	1 436.40	*0.9%*	638.86	644.73	-0.05	5.87

Table 298: Recalculation difference of Cd emissions in general with respect to submission 2011.

		1990			2010			Absolute Diff.	
NFR Cd emissions		**Δ%**	**OLI 2011**	**OLI 2012**	**Δ%**	**OLI 2011**	**OLI 2012**	**1990**	**2010**
1 A 1	Energy Industries	*=*	0.19	0.19	*10.7%*	0.28	0.31	-	0.03
1 A 2	Manufacturing Industries & Construction	*<0.1%*	0.39	0.39	*6.2%*	0.22	0.23	<0.01	0.01
1 A 3	Transport	*<0.1%*	0.06	0.06	*1.0%*	0.10	0.10	<0.01	<0.01
1 A 4	Other Sectors	*<0.1%*	0.42	0.42	*-0.8%*	0.33	0.32	<0.01	<0.01
1 A 5	Other	*<0.1%*	<0.01	<0.01	*0.1%*	<0.01	<0.01	<0.01	<0.01
1 B	Fugitive Emissions	*=*	NA	NA	*=*	NA	NA	-	-
2	Industrial Processes	*=*	0.46	0.46	*=*	0.22	0.22	-	-
3	Solvent & Oth. Prod. Use	*=*	<0.01	<0.01	*=*	<0.01	<0.01	-	-
4	Agriculture	*=*	<0.01	<0.01	*-4.0%*	<0.01	<0.01	-	<0.01
6	Waste	*=*	0.06	0.06	*<0.1%*	<0.01	<0.01	-	<0.01
Total	**Total Emissions**	*<0.1%*	1.58	1.58	*3.6%*	1.14	1.18	<0.01	0.04

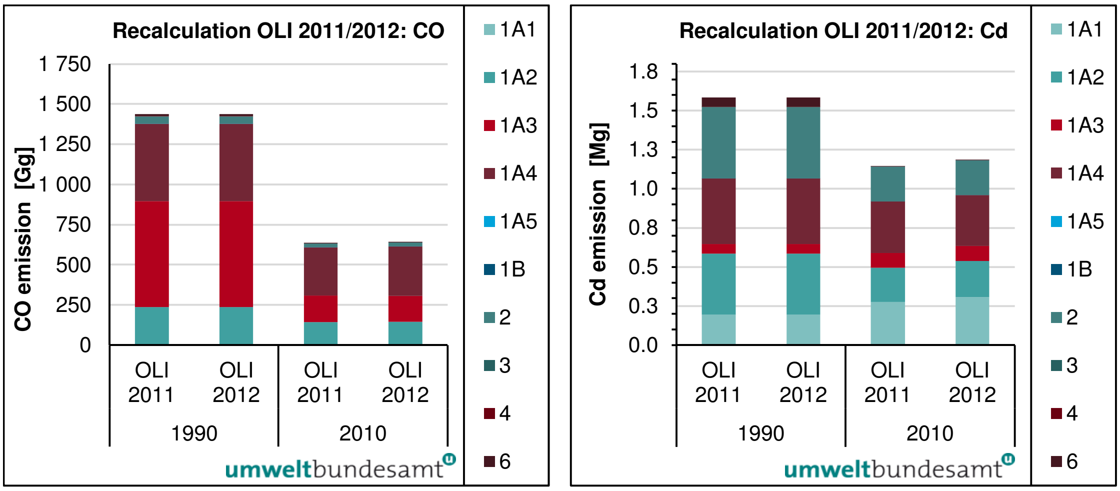

Figure 35: Recalculation difference of CO and Cd emissions with respect to submission 2011.

Table 299: Recalculation difference of Hg emissions in general with respect to submission 2011.

		1990			2010			Absolute Diff.	
NFR Hg emissions		**Δ%**	**OLI 2011**	**OLI 2012**	**Δ%**	**OLI 2011**	**OLI 2012**	**1990**	**2010**
1 A 1	Energy Industries	*=*	0.33	0.33	*8.5%*	0.19	0.21	-	0.02
1 A 2	Manufacturing Industries & Construction	*<0.1%*	0.80	0.80	*2.4%*	0.27	0.28	<0.01	0.01
1 A 3	Transport	*<0.1%*	<0.01	<0.01	*-1.2%*	<0.01	<0.01	<0.01	<0.01
1 A 4	Other Sectors	*<0.1%*	0.43	0.43	*0.2%*	0.18	0.18	<0.01	<0.01
1 A 5	Other	*<0.1%*	<0.01	<0.01	*0.1%*	<0.01	<0.01	<0.01	<0.01
1 B	Fugitive Emissions	*=*	NA	NA	*=*	NA	NA	-	-
2	Industrial Processes	*=*	0.53	0.53	*=*	0.32	0.32	-	-
3	Solvent & Oth. Prod. Use	*=*	NA	NA	*=*	NA	NA	-	-
4	Agriculture	*=*	<0.01	<0.01	*-3.5%*	<0.01	<0.01	-	<0.01
6	Waste	*=*	0.05	0.05	*<0.1%*	0.02	0.02	-	<0.01
Total	**Total Emissions**	*<0.1%*	2.14	2.14	*2.4%*	0.99	1.01	<0.01	0.02

Table 300: Recalculation difference of Pb emissions in general with respect to submission 2011.

		1990			2010			Absolute Diff.	
NFR Pb emissions		**Δ%**	**OLI 2011**	**OLI 2012**	**Δ%**	**OLI 2011**	**OLI 2012**	**1990**	**2010**
1 A 1	Energy Industries	*=*	1.08	1.08	*19.6%*	2.14	2.56	-	0.42
1 A 2	Manufacturing Industries & Construction	*<0.1%*	9.68	9.68	*2.8%*	3.68	3.79	<0.01	0.10
1 A 3	Transport	*<0.1%*	167.48	167.48	*-1.5%*	0.01	0.01	<0.01	<0.01
1 A 4	Other Sectors	*<0.1%*	7.58	7.58	*-1.0%*	2.34	2.32	<0.01	-0.02
1 A 5	Other	*<0.1%*	<0.01	<0.01	*0.1%*	<0.01	<0.01	<0.01	<0.01
1 B	Fugitive Emissions	*=*	NA	NA	*=*	NA	NA	-	-
2	Industrial Processes	*=*	32.09	32.09	*=*	6.65	6.65	-	-
3	Solvent & Oth. Prod. Use	*=*	0.02	0.02	*=*	0.02	0.02	-	-
4	Agriculture	*=*	0.01	0.01	*-4.3%*	0.01	0.01	-	<0.01
6	Waste	*=*	1.02	1.02	*<0.1%*	<0.01	<0.01	-	<0.01
Total	**Total Emissions**	*<0.1%*	218.96	218.96	*3.4%*	14.85	15.35	<0.01	0.50

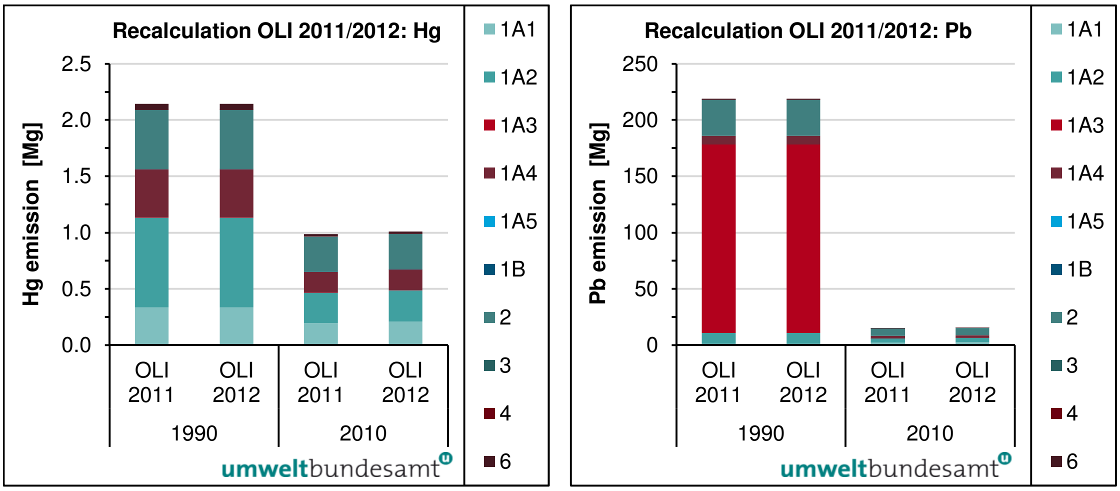

Figure 36: Recalculation difference of Hg and Pb emissions with respect to submission 2011.

Table 301: Recalculation difference of PAH emissions in general with respect to submission 2011.

		1990			2010			Absolute Diff.	
NFR PAH emissions		**Δ%**	**OLI 2011**	**OLI 2012**	**Δ%**	**OLI 2011**	**OLI 2012**	**1990**	**2010**
1 A 1	Energy Industries	*=*	0.01	0.01	*24.9%*	0.02	0.03	-	0.01
1 A 2	Manufacturing Industries & Construction	*<0.1%*	0.07	0.07	*6.4%*	0.23	0.24	<0.01	0.01
1 A 3	Transport	*<0.1%*	0.93	0.93	*-1.0%*	1.68	1.67	<0.01	-0.02
1 A 4	Other Sectors	*<0.1%*	8.53	8.53	*2.2%*	5.65	5.77	<0.01	0.12
1 A 5	Other	*-0.1%*	<0.01	<0.01	*-0.9%*	<0.01	<0.01	<0.01	<0.01
1 B	Fugitive Emissions	*=*	NA	NA	*=*	NA	NA	-	-
2	Industrial Processes	*-6.1%*	7.44	6.98	*=*	0.22	0.22	-0.45	-
3	Solvent & Oth. Prod. Use	*=*	0.15	0.15	*=*	NE	NE	-	-
4	Agriculture	*=*	0.25	0.25	*-2.1%*	0.18	0.17	-	<0.01
6	Waste	*=*	<0.01	<0.01	*=*	<0.01	<0.01	-	-
Total	**Total Emissions**	*-2.6%*	17.37	16.92	*1.5%*	7.98	8.10	-0.45	0.12

Table 302: Recalculation difference of Dioxin/Furan (PCDD/F) emissions in general with respect to submission 2011.

		1990			2010			Absolute Diff.	
NFR Dioxin/Furan emissions		**Δ%**	**OLI 2011**	**OLI 2012**	**Δ%**	**OLI 2011**	**OLI 2012**	**1990**	**2010**
1 A 1	Energy Industries	*=*	0.82	0.82	*24.5%*	1.22	1.51	-	0.30
1 A 2	Manufacturing Industries & Construction	*<0.1%*	52.10	52.10	*6.0%*	6.26	6.64	<0.01	0.38
1 A 3	Transport	*<0.1%*	3.94	3.94	*-1.2%*	1.10	1.09	<0.01	-0.01
1 A 4	Other Sectors	*<0.1%*	45.46	45.46	*2.4%*	26.47	27.12	<0.01	0.64
1 A 5	Other	*-0.1%*	<0.01	<0.01	*-0.9%*	<0.01	<0.01	<0.01	<0.01
1 B	Fugitive Emissions	*=*	NA	NA	*=*	NA	NA	-	-
2	Industrial Processes	*=*	39.00	39.00	*=*	3.35	3.35	-	-
3	Solvent & Oth. Prod. Use	*=*	1.06	1.06	*=*	NE	NE	-	-
4	Agriculture	*=*	0.18	0.18	*-2.2%*	0.13	0.13	-	<0.01
6	Waste	*=*	18.19	18.19	*=*	0.16	0.16	-	-
Total	**Total Emissions**	*<0.1%*	160.76	160.76	*3.4%*	38.70	40.01	<0.01	1.30

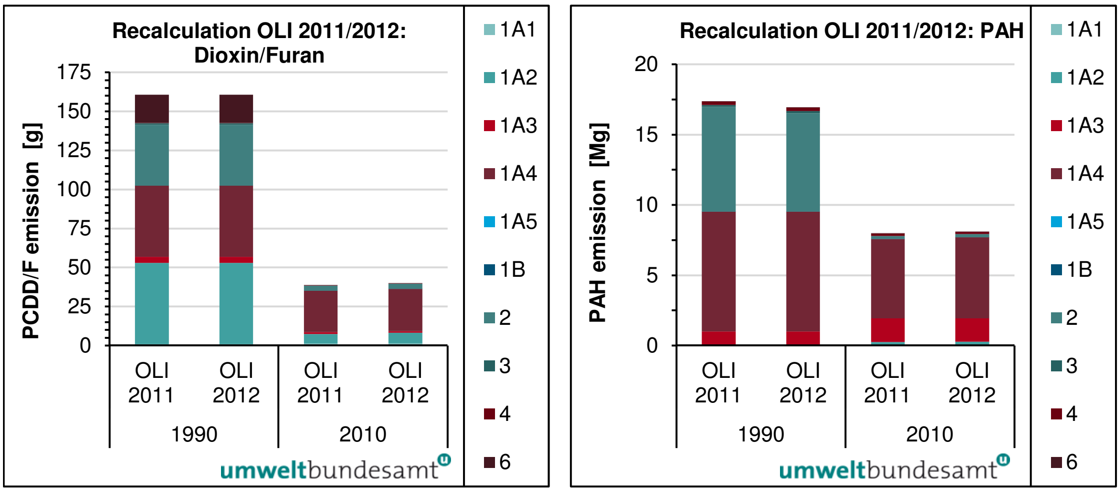

Figure 37: Recalculation difference of Dioxin/Furan and PAH emissions with respect to submission 2011.

Table 303: Recalculation difference of HCB emissions in general with respect to submission 2011.

		1990			2010			Absolute Diff.	
NFR HCB emissions		**Δ%**	**OLI 2011**	**OLI 2012**	**Δ%**	**OLI 2011**	**OLI 2012**	**1990**	**2010**
1 A 1	Energy Industries	*=*	0.21	0.21	*13.8%*	0.44	0.50	-	0.06
1 A 2	Manufacturing Industries & Construction	*<0.1%*	17.45	17.45	*3.5%*	1.67	1.73	<0.01	0.06
1 A 3	Transport	*<0.1%*	0.79	0.79	*-1.2%*	0.22	0.22	<0.01	<0.01
1 A 4	Other Sectors	*<0.1%*	54.31	54.31	*5.9%*	35.12	37.18	<0.01	2.06
1 A 5	Other	*-0.1%*	<0.01	<0.01	*-0.9%*	<0.01	<0.01	<0.01	<0.01
1 B	Fugitive Emissions	*=*	NA	NA	*=*	NA	NA	-	-
2	Industrial Processes	*=*	9.71	9.71	*=*	3.81	3.81	-	-
3	Solvent & Oth. Prod. Use	*=*	9.05	9.05	*=*	NE	NE	-	-
4	Agriculture	*=*	0.04	0.04	*-2.2%*	0.03	0.03	-	<0.01
6	Waste	*=*	0.39	0.39	*=*	0.03	0.03	-	-
Total	**Total Emissions**	*<0.1%*	91.96	91.96	*5.3%*	41.33	43.50	<0.01	2.18

Table 304: Recalculation difference of TSP emissions in general with respect to submission 2011.

		1990			2010			Absolute Diff.	
NFR TSP emissions		**Δ%**	**OLI 2011**	**OLI 2012**	**Δ%**	**OLI 2011**	**OLI 2012**	**1990**	**2010**
1 A 1	Energy Industries	*=*	1 031	1 031	*10.3%*	1 480	1 632	-	151.73
1 A 2	Manufacturing Industries & Construction	*0.1%*	2 879	2 881	*3.5%*	4 570	4 729	1.68	159.72
1 A 3	Transport	*<0.1%*	11 977	11 977	*-0.3%*	15 157	15 115	-0.75	-41.28
1 A 4	Other Sectors	*-0.2%*	14 160	14 131	*-1.4%*	10 291	10 146	-29.22	-144.84
1 A 5	Other	*-0.1%*	17	17	*-0.1%*	17	17	-0.02	-0.02
1 B	Fugitive Emissions	*2.4%*	647	663	*2.6%*	467	479	15.58	12.22
2	Industrial Processes	*=*	18 539	18 539	*<0.1%*	15 390	15 394	-	4.23
3	Solvent & Oth. Prod. Use	*=*	407	407	*=*	445	445	-	-
4	Agriculture	*=*	12 738	12 738	*0.2%*	12 019	12 040	-	21.54
6	Waste	*=*	146	146	*16.9%*	170	199	-	28.76
Total	**Total Emissions**	*<0.1%*	62 541	62 528	*0.3%*	60 005	60 197	-12.73	192.06

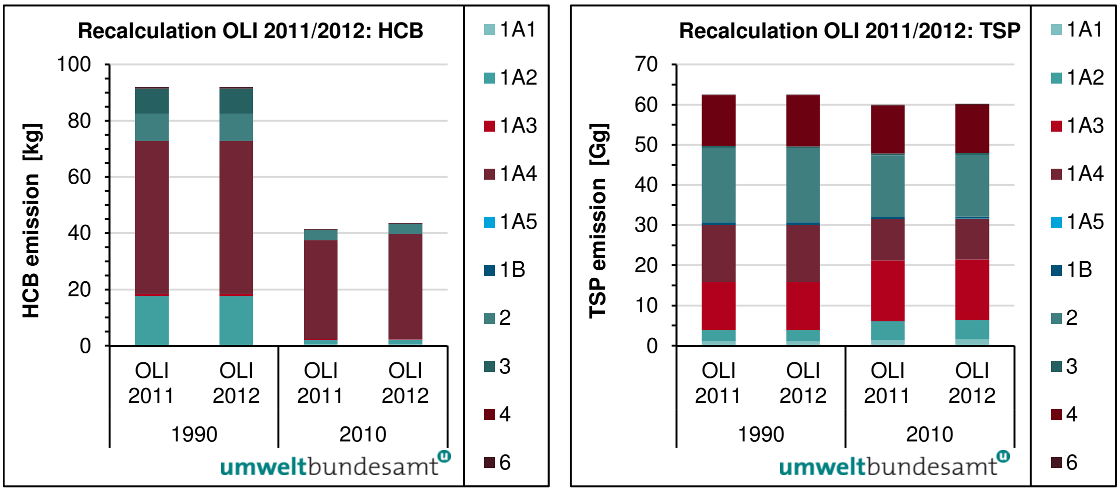

Figure 38: Recalculation difference of HCB and TSP emissions with respect to submission 2011.

Table 305: Recalculation difference of PM10 emissions in general with respect to submission 2011.

		1990			2010			Absolute Diff.	
NFR PM10 emissions		**Δ%**	**OLI 2011**	**OLI 2012**	**Δ%**	**OLI 2011**	**OLI 2012**	**1990**	**2010**
1 A 1	Energy Industries	*=*	977	977	*10.1%*	1 356	1 493	-	136.64
1 A 2	Manufacturing Industries & Construction	*0.1%*	2 487	2 489	*4.2%*	3 406	3 549	1.68	142.59
1 A 3	Transport	*<0.1%*	6 377	6 376	*-1.6%*	7 339	7 218	-0.75	-120.58
1 A 4	Other Sectors	*-0.2%*	12 875	12 846	*-1.5%*	9 264	9 129	-29.22	-134.45
1 A 5	Other	*-0.1%*	16	16	*-0.1%*	17	17	-0.02	-0.01
1 B	Fugitive Emissions	*2.4%*	305	312	*2.6%*	221	227	7.34	5.78
2	Industrial Processes	*=*	10 450	10 450	*-0.1%*	7 560	7 552	-	-7.71
3	Solvent & Oth. Prod. Use	*=*	407	407	*=*	445	445	-	-
4	Agriculture	*=*	5 809	5 809	*0.1%*	5 464	5 472	-	7.71
6	Waste	*=*	70	70	*16.9%*	80	94	-	13.61
Total	**Total Emissions**	*-0.1%*	39 772	39 751	*0.1%*	35 152	35 196	-20.97	43.57

Table 306: Recalculation difference of PM2.5 emissions in general with respect to submission 2011.

		1990			2010			Absolute Diff.	
NFR PM2.5 emissions		**Δ%**	**OLI 2011**	**OLI 2012**	**Δ%**	**OLI 2011**	**OLI 2012**	**1990**	**2010**
1 A 1	Energy Industries	*=*	833	833	*1<0.1%*	1 148	1 263	-	114.55
1 A 2	Manufacturing Industries & Construction	*-0.6%*	2 076	2 063	*3.9%*	2 507	2 605	-12.87	97.49
1 A 3	Transport	*<0.1%*	4 416	4 415	*-3.2%*	4 602	4 454	-0.75	-148.33
1 A 4	Other Sectors	*-0.3%*	11 675	11 645	*-1.5%*	8 336	8 212	-29.22	-124.06
1 A 5	Other	*-0.1%*	16	16	*-0.1%*	16	16	-0.02	-0.01
1 B	Fugitive Emissions	*2.4%*	95	97	*2.6%*	70	72	2.29	1.82
2	Industrial Processes	*=*	3 240	3 240	*-0.8%*	1 389	1 378	-	-11.35
3	Solvent & Oth. Prod. Use	*=*	407	407	*=*	445	445	-	-
4	Agriculture	*=*	1 396	1 396	*-0.1%*	1 292	1 291	-	-1.09
6	Waste	*=*	23	23	*16.8%*	25	30	-	4.28
Total	**Total Emissions**	*-0.2%*	24 176	24 135	*-0.3%*	19 831	19 764	-40.57	-66.71

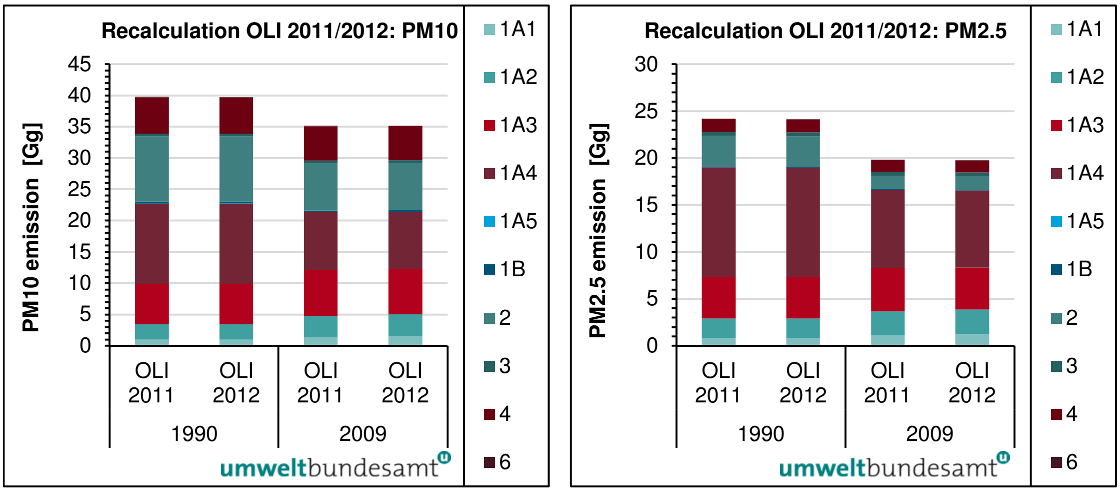

Figure 39: Recalculation difference of PM10 and PM2.5 emissions with respect to submission 2011.

9 PROJECTIONS

As outlined in the 'Guidelines for Reporting Emission Data under the Convention on Long-Range Transboundary Air Pollution' (ECE/EB.AIR/2008/4)

§ 36 parties to the Gothenburg Protocol shall report their latest available projections at least every five years, and provide any updated projections annually by 15 February, for the years 2010, 2015, 2020, 2030 and 2050.

§ 37 projected emissions for sulphur dioxide (SO_2), nitrogen oxides (NO_x), ammonia (NH_3), particulate matter-10 (PM10), PM2.5 and non-methane volatile organic compounds (NMVOCs) should be reported using table IV.2a of annex IV to these Guidelines. Parties should complete the tables at the requested level of aggregation. Where values for individual categories or aggregated NFR categories are not available, the notation keys defined in section II.C of annex I to these Guidelines should be used.

Austria presents emission projections "with existing measures" for 2010, 2015, 2020 and 2030 in the report 'AUSTRIA'S NATIONAL AIR EMISSION PROJECTIONS 2010–2030. Submission under the UN/ECE Convention on Long-Range Transboundary Air Pollution (UMWELTBUNDESAMT 2011e). The report includes background information to enable a quantitative understanding of the key socioeconomic assumptions used in the preparation of the projections. An Update for the air emissions projection will be published in summer 2013.

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11 ABBREVIATIONS

AMA	Agrarmarkt Austria
AWMS	Animal Waste Management System
BAWP	Bundes-Abfallwirtschaftsplan (Federal Waste Management Plan)
BMLFUW	Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (Federal Ministry for Agriculture, Forestry, Environment and Water Management)
BMUJF	Bundesministerium für Umwelt, Jugend und Familie (Federal Ministry for Environment, Youth and Family (before 2000, now domain of Environment: BMLFUW))
BUWAL	Bundesamt für Umwelt, Wald und Landschaft. Bern (The Swiss Agency for the Environment, Forests and Landscape (SAEFL), Bern)
CORINAIR	Core Inventory Air
CORINE	Coordination d´information Environmentale
CRF	Common Reporting Format
DKDB	Dampfkesseldatenbank (Austrian annual steam boiler inventory)
EC	European Community
EDM	Electronic Data Management
EEA	European Environment Agency
EIONET	European Environment Information and Observation NETwork
EMEP	Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
ETS	Emission Trading System
EPER	European Pollutant Emission Register
GDP	Gross Domestic Product
GLOBEMI	Globale Modellbildung für Emissions- und Verbrauchsszenarien im Verkehrssektor ((Global Modelling for Emission- and Fuel consumption Scenarios of the Transport Sector) see (Hausberger 1998))
GPG	Good Practice Guidance (of the IPCC)
HBEFA	“Handbook of Emission Factors”
HM	Heavy Metals
IEA	International Energy Agency
IEF	Implied emission factor
IFR	Instrument Flight Rules
IIR	Informative Inventory Report
IPCC	Intergovernmental Panel on Climate Change
LTO	Landing/Take-Off cycle
MCF	Methane Conversion Factor
MEET	MEET – Methodology for calculating transport emissions and energy consumption

NACE	Nomenclature des activites economiques de la Communaute Europeenne
NAPFUE	Nomenclature for Air Pollution Fuels
NEC	National Emissions Ceiling (Directive 2001/81/EC of The European Parliament And Of The Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants – NEC Directive)
NFR	Nomenclature for Reporting (Format of Reporting under the UNECE/LRTAP Convention)
NIR	National Inventory Report (Submission under the United Nations Framework Convention on Climate Change)
NISA	National Inventory System Austria
OECD	Organisation for Economic Co-operation and Development
ODS	Ozone depleting substances
OLI	Österreichische Luftschadstoff InventurAustrian Air Emission Inventory
PHARE	Phare is the acronym of the Programme's original name: 'Poland and Hungary: Action for the Restructuring of the Economy'. It covers now 14 partner countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, the Former Yugoslav Republic of Macedonia (FYROM), Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia, (However, Croatia was suspended from the Phare Programme in July 1995.)
PM	Particular Matter
POP	Persistent Organic Pollutants
PRTR	Pollution Release and Transfer Register
QA/QC	Quality Assurance/Quality Control
QMS	Quality Management System
RWA	Raiffeisen Ware Austria (see www.rwa.at)
SNAP	Selected Nomenclature on Air Pollutants
SOP	Standard Operation Procedure
TAN	Total ammoniacal nitrogen
Umweltbundesamt	Umweltbundesamt (Environment Agency Austria)
UNECE/LRTAP	United Nations Economic Commission for Europe.Convention on Long-range Transboundary Air Pollution
UNFCCC	United Nations Framework Convention on Climate Change
VFR	Visual Flight Rules
VRF	Variable Refrigerant Flow
VMOe	Verkehrs-Mengenmodell-Oesterreich
WIFO	Wirtschaftsforschungsinstitut (Austrian Institute for Economic Research)

Chemical Symbols

Symbol	Name

Greenhouse gases

CH_4	Methane
CO_2	Carbon Dioxide
N_2O	Nitrous Oxide
HFCs	Hydroflurocarbons
PFCs	Perfluorocarbons
SF_6	Sulphur hexafluoride

Further chemical compounds

CO	Carbon Monoxide
Cd	Cadmium
NH_3	Ammonia
Hg	Mercury
NO_X	Nitrogen Oxides (NO plus NO_2)
NO_2	Nitrogen Dioxide
NMVOC	Non-Methane Volatile Organic Compounds
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
POP	Persistent Organic Pollutants
SO_2	Sulfur Dioxide
SO_X	Sulfur Oxides

Units and Metric Symbols

UNIT	Name	Unit for
g	gram	mass
t	ton	mass
W	watt	power
J	joule	calorific value
m	meter	length

Mass Unit Conversion		
1g		
1kg	= 1 000 g	
1t	= 1 000 kg	= 1 Mg
1kt	= 1 000 t	= 1 Gg
1Mt	= 1 Mio t	= 1 Tg

Metric Symbol	Prefix	Factor
P	peta	10^{15}
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
h	hecto	10^{2}
da	deca	10^{1}
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
µ	micro	10^{-6}
n	nano	10^{-9}

12 ANNEX

1. NFR for 2013
2. Footnotes to NFR
3. Emission trends per sector – submission under UNECE/LRTAP
4. Austria's emissions for SO_2, NO_x, NMVOC and NH_3 according to the submission under NEC directive
5. Extracts from Austrian Legislation

12.1 Nomenclature for Reporting (NFR) – Format of Reporting under the UNECE/LRTAP Convention

12.1.1 NFR for 2013

(a) Sectors already reported to UNFCCC for NO_x, CO, NMVOC, SO_2.

(b) Including NH_3 from Enteric Fermentation and emissions from Cultivation of Rice.

(c) Including PM sources.

(d) Excludes waste incineration for energy (this is included in 1 A 1) and in industry (if used as fuel).

(e) Includes accidental fires.

(f) National Total refers to the territory declared upon ratification of the relevant Protocol of the Convention.

(g) EMEP grid domain is defined in the Emission Reporting Guidelines (ECE/EB.AIR/80/Annex V).

(h) Member States of the European Union may use this template for reporting under the National Emissions Ceiling Directive (NECD); MS should consult the text of the NECD to determine what should be included within the NEC Total, as this may differ from the LRTAP National Total in terms of its geographic coverage, sectors (e.g. inclusion/exclusion of international aviation and inland shipping activities) etc.

(i) Member States of the European Union may use this line for reporting of transport emissions if based on fuel used.

Note 1:
Main Pollutants should cover the time span from 1980 to latest year.
HM should cover the time span from 1990 to latest year.
POPs should cover the time span from 1990 to the latest year.
PM should cover the time span from 2000 to latest year.

Notes 2:

(1) The POPs listed in annex I to the Protocol on POPs are substances scheduled for elimination; DDT and PCBs are also listed in annex I;

(2) The POPs listed in annex II to the Protocol on POPs are substances scheduled for restrictions on use;

(3) The POPs listed in annex III to the Protocol on POPs are substances referred to in article 3, para. 5 (a), of the Protocol. Polycyclic aromatic hydrocarbons (PAHs): For the purpose of the emission inventories, the following four indicator compounds should be used: benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene. HCB is also included in annex I to the Protocol as a substance for elimination.

(4) See article 8 of the Protocol (Research, development and monitoring; reporting voluntary).

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

AT: 19.12.2012: 2011	*NFR sectors to be reported to LRTAP*				NECD pollutants **Main Pollutants** (from 1980)				**Particulate Matter** (from 2000)			**Other** (from 1980)	**Priority Heavy Metals** (from 1990)			**Other Heavy Metals** (from 1990)					
					NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot ati*	*Longname*	**Notes:**	**Gg NO_2**	**Gg**	**Gg SO_2**	**Gg**	**Gg**	**Gg**	**Gg**	**Gg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**
A_PublicPower	1 A 1 a	(a)	1 A 1 a Public electricity and heat production		11,06	0,95	2,52	0,37													
B_IndustrialComb	1 A 1 b	(a)	1 A 1 b Petroleum refining		0,90	IE	0,44	0,09													
B_IndustrialComb	1 A 1 c	(a)	1 A 1 c Manufacture of solid fuels and other energy industries		1,63	0,01	NA	0,01													
B_IndustrialComb	1 A 2 a	(a)	1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel		4,32	0,27	5,10	0,04													
B_IndustrialComb	1 A 2 b	(a)	1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals		0,21	0,00	0,08	0,00													
B_IndustrialComb	1 A 2 c	(a)	1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals		1,30	0,22	0,56	0,03													
B_IndustrialComb	1 A 2 d	(a)	1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print		5,06	0,25	1,09	0,07													
B_IndustrialComb	1 A 2 e	(a)	1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco		0,78	0,01	0,20	0,02													
B_IndustrialComb	1 A 2 f i		1 A 2 f i Stationary combustion in manufacturing industries and construction: Other (Please specify in your IIR)		12,94	0,78	4,28	0,26													
I_OffRoadMob	1 A 2 f ii		1 A 2 f ii Mobile Combustion in manufacturing industries and construction: (Please specify in your IIR)		7,67	0,90	0,01	0,00													
J_ AviLTO	1 A 3 a ii (i)		1 A 3 a ii (i) Civil aviation (Domestic, LTO)		0,07	0,12	0,01	0,00													
J_AviLTO	1 A 3 a i (i)		1 A 3 a i (i) International aviation (LTO)		1,22	0,44	0,10	0,00													
G_RoadRail	1 A 3 b i		1 A 3 b i Road transport: Passenger cars		29,98	4,28	0,05	0,81													
G_RoadRail	1 A 3 b ii		1 A 3 b ii Road transport:Light duty vehicles		5,66	0,30	0,01	0,02													
G_RoadRail	1 A 3 b iii		1 A 3 b iii Road transport:, Heavy duty vehicles		28,93	2,12	0,02	0,03													
G_RoadRail	1 A 3 b iv		1 A 3 b iv Road transport: Mopeds & motorcycles		0,48	1,73	NA	0,00													
G_RoadRail	1 A 3 b v		1 A 3 b v Road transport: Gasoline evaporation		NA	1,96	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
G_RoadRail	1 A 3 b vi		1 A 3 b vi Road transport: Automobile tyre and brake wear		NA	NA	NA	NA				NA									
G_RoadRail	1 A 3 b vii		1 A 3 b vii Road transport: Automobile road abrasion		NA	NA	NA	NA				NA									
G_RoadRail	1 A 3 c	(a)	1 A 3 c Railways		1,66	0,25	0,06	0,00													
H_Shipping	1 A 3 d i (ii)		1 A 3 d i (ii) International inland waterways		0,51	NA	0,01	0,00													
H_Shipping	1 A 3 d ii	(a)	1 A 3 d ii National navigation (Shipping)		0,06	0,27	0,00	0,00													
B_IndustrialComb	1 A 3 e		1 A 3 e Pipeline compressors		1,06	0,00	NA	0,01													
C_SmallComb	1 A 4 a i		1 A 4 a i Commercial / institutional: Stationary		1,90	0,47	0,34	0,07													
I_OffRoadMob	1 A 4 a ii		1 A 4 a ii Commercial / institutional: Mobile		IE	IE	IE	IE													
C_SmallComb	1 A 4 b i		1 A 4 b i Residential: Stationary plants		10,21	23,10	1,92	0,50													
I_OffRoadMob	1 A 4 b ii		1 A 4 b ii Residential: Household and gardening (mobile)		0,66	1,53	0,00	0,00													

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

AT: 19.12.2012: 2011	***NFR sectors to be reported to LRTAP***			**POPs** (1) (from 1990)									**Activity Data** (From 1990)						
				PCDD/ PCDF (dioxines/ furanes)	PAHs					HCB	HCH	PCBs	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	*Other activity (specified)*	*Other Activity Units*
					benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4										
NFR Aggregation for Gridding and LPS (GNFR)	***NFR Code***	*annot ati*	***Longname***	**g I-Teq**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**kg**	**kg**	**kg**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**		
A_PublicPower	1 A 1 a	(a)	1 A 1 a Public electricity and heat production							NA	NA							*NA*	*TJ NCV*
B_IndustrialComb	1 A 1 b	(a)	1 A 1 b Petroleum refining							NA	NA							*NA*	*TJ NCV*
B_IndustrialComb	1 A 1 c	(a)	1 A 1 c Manufacture of solid fuels and other energy industries							NA	NA							*NA*	*TJ NCV*
B_IndustrialComb	1 A 2 a	(a)	1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel							NA	NA							*NA*	*TJ NCV*
B_IndustrialComb	1 A 2 b	(a)	1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals							NA	NA							*NA*	*TJ NCV*
B_IndustrialComb	1 A 2 c	(a)	1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals							NA	NA							*NA*	*TJ NCV*
B_IndustrialComb	1 A 2 d	(a)	1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print							NA	NA							*NA*	*TJ NCV*
B_IndustrialComb	1 A 2 e	(a)	1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco							NA	NA							*NA*	*TJ NCV*
B_IndustrialComb	1 A 2 f i		1 A 2 f i Stationary combustion in manufacturing industries and construction: Other (Please specify in your IIR)							NA	NA							*NA*	*TJ NCV*
I_OffRoadMob	1 A 2 f ii		1 A 2 f ii Mobile Combustion in manufacturing industries and construction: (Please specify in your IIR)							NA	NA	NA						*NA*	*TJ NCV*
J_ AviLTO	1 A 3 a ii (i)		1 A 3 a ii (i) Civil aviation (Domestic, LTO)							NA	NA			NA	NA	NA	NA	*NA*	*TJ NCV*
J_AviLTO	1 A 3 a i (i)		1 A 3 a i (i) International aviation (LTO)							NA	NA			NA	NA	NA	NA	*NA*	*TJ NCV*
G_RoadRail	1 A 3 b i		1 A 3 b i Road transport: Passenger cars								NA			NA			NA	*NA*	*TJ NCV*
G_RoadRail	1 A 3 b ii		1 A 3 b ii Road transport:Light duty vehicles								NA			NA		NA	NA	*NA*	*TJ NCV*
G_RoadRail	1 A 3 b iii		1 A 3 b iii Road transport:, Heavy duty vehicles								NA			NA		NA	NA	*NA*	*TJ NCV*
G_RoadRail	1 A 3 b iv		1 A 3 b iv Road transport: Mopeds & motorcycles								NA			NA		NA	NA	*NA*	*TJ NCV*
G_RoadRail	1 A 3 b v		1 A 3 b v Road transport: Gasoline evaporation						NA		NA			NA	NA	NA	NA	*NA*	*TJ NCV*
G_RoadRail	1 A 3 b vi		1 A 3 b vi Road transport: Automobile tyre and brake wear	NA							NA		NA	NA	NA	NA	NA		*10^6 km*
G_RoadRail	1 A 3 b vii		1 A 3 b vii Road transport: Automobile road abrasion	NA							NA		NA	NA	NA	NA	NA		*10^6 km*
G_RoadRail	1 A 3 c	(a)	1 A 3 c Railways							NA	NA				NA	NA	NA	*NA*	*TJ NCV*
H_Shipping	1 A 3 d i (ii)		1 A 3 d i (ii) International inland waterways								NA				NA	NA	NA	*NA*	*TJ NCV*
H_Shipping	1 A 3 d ii	(a)	1 A 3 d ii National navigation (Shipping)								NA				NA	NA	NA	*NA*	*TJ NCV*
B_IndustrialComb	1 A 3 e		1 A 3 e Pipeline compressors								NA			NA		NA	NA	*NA*	*TJ NCV*
C_SmallComb	1 A 4 a i		1 A 4 a i Commercial / institutional: Stationary								NA			NA		NA	NA	*NA*	*TJ NCV*
I_OffRoadMob	1 A 4 a ii		1 A 4 a ii Commercial / institutional: Mobile								NA	NA						*NA*	*TJ NCV*
C_SmallComb	1 A 4 b i		1 A 4 b i Residential: Stationary plants								NA							*NA*	*TJ NCV*
I_OffRoadMob	1 A 4 b ii		1 A 4 b ii Residential: Household and gardening (mobile)								NA	NA						*NA*	*TJ NCV*

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

					NECD pollutants																
AT: 19.12.2012: 2011	***NFR sectors to be reported to LRTAP***				**Main Pollutants** (from 1980)				**Particulate Matter** (from 2000)			**Other** (from 1980)	**Priority Heavy Metals** (from 1990)			**Other Heavy Metals** (from 1990)					
					NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
NFR Aggregation for Gridding and LPS (GNFR)	***NFR Code***	*annot ati*	***Longname***	**Notes:**	**Gg NO_2**	**Gg**	**Gg SO_2**	**Gg**	**Gg**	**Gg**	**Gg**	**Gg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**
C_SmallComb	1 A 4 c i		1 A 4 c i Agriculture/Forestry/Fishing: Stationary		0,95	1,56	0,18	0,04													
I_OffRoadMob	1 A 4 c ii		1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery		7,74	3,26	0,01	0,00													
H_Shipping	1A 4 c iii		1A 4 c iii Agriculture/Forestry/Fishing: National fishing		NO	NO	NO	NO													
C_SmallComb	1 A 5 a	(a)	1 A 5 a Other stationary (including military)		IE	IE	IE	IE													
I_OffRoadMob	1 A 5 b	(a)	1 A 5 b Other, Mobile (including military, land based and recreational boats)		0,08	0,02	0,01	0,00													
E_Fugitive	1 B 1 a	(a)	1 B 1 a Fugitive emission from solid fuels: Coal mining and handling		NA	NA	NA	NA				NA									
E_Fugitive	1 B 1 b	(a)	1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation		IE	IE	IE	IE													
E_Fugitive	1 B 1 c	(a)	1 B 1 c Other fugitive emissions from solid fuels		NO	NO	NO	NO													
E_Fugitive	1 B 2 a i		1 B 2 a i Exploration, production, transport		NA	0,50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E_Fugitive	1 B 2 a iv		1 B 2 a iv Refining / storage		NA	0,73	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E_Fugitive	1 B 2 a v		1 B 2 a v Distribution of oil products		NA	0,68	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E_Fugitive	1 B 2 b	(a)	1 B 2 b Natural gas		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E_Fugitive	1 B 2 c	(a)	1 B 2 c Venting and flaring		NA	0,02	0,23	NA													
E_Fugitive	1 B 3		1 B 3 Other fugitive emissions from geothermal energy production , peat and other energy extraction not included in 1 B 2		IE	IE	IE	IE													
D_IndProcess	2 A 1	(a)	2 A 1 Cement production		NA	NA	NA	NA													
D_IndProcess	2 A 2	(a)	2 A 2 Lime production		NA	NA	NA	NA								NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 3	(a)	2 A 3 Limestone and dolomite use		NA	NA	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 4	(a)	2 A 4 Soda ash production and use		NA	NA	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 5	(a)	2 A 5 Asphalt roofing		NA	IE	NA	NA								NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 6	(a)	2 A 6 Road paving with asphalt		NA	IE	NA	NA					NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 7 a		2 A 7 a Quarrying and mining of minerals other than coal		NA	NA	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 7 b		2 A 7 b Construction and demolition		NA	NA	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 7 c		2A 7 c Storage, handling and transport of mineral products		IE	IE	IE	IE				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 A 7 d		2 A 7 d Other Mineral products (Please specify the sources included/excluded in the notes column to the right)		NA	NA	NA	NA													
D_IndProcess	2 B 1	(a)	2 B 1 Ammonia production		0,18	IE	NA	0,01					NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 B 2	(a)	2 B 2 Nitric acid production		0,12	NA	NA	0,01				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

AT: 19.12.2012: 2011	*NFR sectors to be reported to LRTAP*			**POPs** [(1)] (from 1990)									**Activity Data** (From 1990)						
					PAHs														
				PCDD/ PCDF (dioxines/ furanes)	benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4	HCB	HCH	PCBs	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	*Other activity (specified)*	*Other Activity Units*
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot ati*	*Longname*	**g I-Teq**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**kg**	**kg**	**kg**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**		
C_SmallComb	1 A 4 c i		1 A 4 c i Agriculture/Forestry/Fishing: Stationary								NA							*NA*	*TJ NCV*
I_OffRoadMob	1 A 4 c ii		1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery								NA			NA	NA		NA	*NA*	*TJ NCV*
H_Shipping	1A 4 c iii		1A 4 c iii Agriculture/Forestry/Fishing: National fishing								NA	NA		NA	NA		NA	*NA*	*TJ NCV*
C_SmallComb	1 A 5 a	(a)	1 A 5 a Other stationary (including military)								NA	NA						*NA*	*TJ NCV*
I_OffRoadMob	1 A 5 b	(a)	1 A 5 b Other, Mobile (including military, land based and recreational boats)								NA	NA		NA	NA		NA	*NA*	*TJ NCV*
E_Fugitive	1 B 1 a	(a)	1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*coal produced [Mt]*
E_Fugitive	1 B 1 b	(a)	1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	NA						NA	NA	NA	NA	NA	NA	NA	NA		*coal used for transformation [Mt]*
E_Fugitive	1 B 1 c	(a)	1 B 1 c Other fugitive emissions from solid fuels		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Please specify*
E_Fugitive	1 B 2 a i		1 B 2 a i Exploration, production, transport		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Crude Oil produced [Mt]*
E_Fugitive	1 B 2 a iv		1 B 2 a iv Refining / storage		NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA		*Crude Oil Refined [Mt]*
E_Fugitive	1 B 2 a v		1 B 2 a v Distribution of oil products		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Oil Consumed [Mt]*
E_Fugitive	1 B 2 b	(a)	1 B 2 b Natural gas		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Gas throughput [Mn3]*
E_Fugitive	1 B 2 c	(a)	1 B 2 c Venting and flaring							NA	NA	NA	NA	NA	NA	NA	NA		*Gas vented Flared [TJ]*
E_Fugitive	1 B 3		1 B 3 Other fugitive emissions from geothermal energy production , peat and other energy extraction not included in 1 B 2										NA	NA	NA	NA	NA		*Geothermal energy extracted [Tj]*
D_IndProcess	2 A 1	(a)	2 A 1 Cement production								NA		NA	NA	NA	NA	NA		*Clinker Production [kt]*
D_IndProcess	2 A 2	(a)	2 A 2 Lime production		NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA		*Lime Produced [kt]*
D_IndProcess	2 A 3	(a)	2 A 3 Limestone and dolomite use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Limestone and Dolomite used [kt]*
D_IndProcess	2 A 4	(a)	2 A 4 Soda ash production and use	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Soda Ash Production kt*
D_IndProcess	2 A 5	(a)	2 A 5 Asphalt roofing								NA	NA	NA	NA	NA	NA	NA		*Roofing Material Production [Mio m2]*
D_IndProcess	2 A 6	(a)	2 A 6 Road paving with asphalt								NA	NA	NA	NA	NA	NA	NA		*Asphalt Production [kt]*
D_IndProcess	2 A 7 a		2 A 7 a Quarrying and mining of minerals other than coal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Material quarried [Mt]*
D_IndProcess	2 A 7 b		2 A 7 b Construction and demolition	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*floor space constructed/demolished [M3]*
D_IndProcess	2 A 7 c		2A 7 c Storage, handling and transport of mineral products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Amount [Mt]*
D_IndProcess	2 A 7 d		2 A 7 d Other Mineral products (Please specify the sources included/excluded in the notes column to the right)								NA	NA	NA	NA	NA	NA	NA		*Please specify*
D_IndProcess	2 B 1	(a)	2 B 1 Ammonia production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Ammonia Production [kt]*
D_IndProcess	2 B 2	(a)	2 B 2 Nitric acid production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Nitric Acid Production [kt]*

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

					NECD pollutants																	
AT: 19.12.2012: 2011	*NFR sectors to be reported to LRTAP*				**Main Pollutants** (from 1980)				**Particulate Matter** (from 2000)			**Other** (from 1980)	**Priority Heavy Metals** (from 1990)			**Other Heavy Metals** (from 1990)						
					NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot ati*	*Longname*	**Notes:**	**Gg NO_2**	**Gg**	**Gg SO_2**	**Gg**	**Gg**	**Gg**	**Gg**	**Gg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**
D_IndProcess	2 B 3	(a)	2 B 3 Adipic acid production		NO	NO	NO	NO					NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 B 4	(a)	2 B 4 Carbide production		NA	NA	NA	NA													
D_IndProcess	2 B 5 a		2 B 5 a Other chemical industry (Please specify the sources included/excluded in the notes column to the right)		0,08	1,32	0,77	0,08													
D_IndProcess	2 B 5 b		2 B 5 b Storage, handling and transport of chemical products (Please specify the sources included/excluded in the notes column to the right)		NA	NA	NA	NA													
D_IndProcess	2 C 1	(a)	2 C 1 Iron and steel production		0,08	0,25	0,05	IE													
D_IndProcess	2 C 2	(a)	2 C 2 Ferroalloys production		NA	NA	NA	NA													
D_IndProcess	2 C 3	(a)	2 C 3 Aluminum production		NO	NO	NO	NO													
D_IndProcess	2 C 5 a		2 C 5 a Copper production		NO	NO	NO	NO													
D_IndProcess	2 C 5 b		2 C 5 b Lead production		NO	NO	NO	NO													
D_IndProcess	2 C 5 c		2 C 5 c Nickel production		NO	NO	NO	NO													
D_IndProcess	2 C 5 d		2 C 5 d Zinc production		NO	NO	NO	NO													
D_IndProcess	2 C 5 e		2 C 5 e Other metal production (Please specify the sources included/excluded in the notes column to the right)		0,02	0,20	0,40	NA													
D_IndProcess	2 C 5 f		2 C 5 f Storage, handling and transport of metal products (Please specify the sources included/excluded in the notes column to the right)		NA	NA	NA	NA													
D_IndProcess	2 D 1	(a)	2 D 1 Pulp and paper		1,01	0,74	NA	NA					NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 D 2	(a)	2 D 2 Food and drink		NA	2,39	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 D 3		2 D 3 Wood processing		NA	NA	NA	NA					NA	NA	NA		NA		NA	NA	NA
D_IndProcess	2 E		2 E Production of POPs		NO	NO	NO	NO					NA	NA	NA	NA	NA	NA	NA	NA	NA
D_IndProcess	2 F		2 F Consumption of POPs and heavy metals (e.g. electricial and scientific equipment)		NA	NA	NA	NA	NA	NA	NA	NA									
D_IndProcess	2 G		2 G Other production, consumption, storage, transportation or handling of bulk products (Please specify the sources included/excluded in the notes column to the right)		NA	NA	NA	0,00													
F_Solvents	3 A 1		3 A 1 Decorative coating application	Default AD-Unit has been	NA	8,50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 A 2		3 A 2 Industrial coating application	Default AD-Unit has been	NA	11,86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 A 3		3 A 3 Other coating application (Please specify the sources included/excluded in the notes column to the right)		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 B 1		3 B 1 Degreasing		NA	9,58	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 B 2		3 B 2 Dry cleaning		NA	0,38	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 C	(a)	3 C Chemical products	Default AD-Unit has been	NA	6,15	NA	NA													

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AT: 19.12.2012: 2011	*NFR sectors to be reported to LRTAP*			**POPs** (1) (from 1990)									**Activity Data** (From 1990)							
				PCDD/ PCDF (dioxines/ furanes)	PAHs					HCB	HCH	PCBs	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	*Other activity (specified)*	*Other Activity Units*
					benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4										
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot ati*	*Longname*	**g I-Teq**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**kg**	**kg**	**kg**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**		
D_IndProcess	2 B 3	(a)	2 B 3 Adipic acid production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Adipic Acid Production [kt]*
D_IndProcess	2 B 4	(a)	2 B 4 Carbide production								NA	NA	NA	NA	NA	NA	NA		*Carbide Production [kt]*
D_IndProcess	2 B 5 a		2 B 5 a Other chemical industry (Please specify the sources included/excluded in the notes column to the right)										NA	NA	NA	NA	NA		*Please specify*
D_IndProcess	2 B 5 b		2 B 5 b Storage, handling and transport of chemical products (Please specify the sources included/excluded in the notes column to the right)										NA	NA	NA	NA	NA		*Please specify*
D_IndProcess	2 C 1	(a)	2 C 1 Iron and steel production								NA		NA	NA	NA	NA	NA		*Steel Produced [kt]*
D_IndProcess	2 C 2	(a)	2 C 2 Ferroalloys production								NA	NA	NA	NA	NA	NA	NA		*Ferroalloys Production [kt]*
D_IndProcess	2 C 3	(a)	2 C 3 Aluminum production								NA	NA	NA	NA	NA	NA	NA		*Aluminium production [kt]*
D_IndProcess	2 C 5 a		2 C 5 a Copper production								NA		NA	NA	NA	NA	NA		*Copper production [kt]*
D_IndProcess	2 C 5 b		2 C 5 b Lead production								NA		NA	NA	NA	NA	NA		*Lead production [kt]*
D_IndProcess	2 C 5 c		2 C 5 c Nickel production								NA		NA	NA	NA	NA	NA		*Nickel production [kt]*
D_IndProcess	2 C 5 d		2 C 5 d Zinc production								NA		NA	NA	NA	NA	NA		*Zinc production [kt]*
D_IndProcess	2 C 5 e		2 C 5 e Other metal production (Please specify the sources included/excluded in the notes column to the right)										NA	NA	NA	NA	NA		*Please specify*
D_IndProcess	2 C 5 f		2 C 5 f Storage, handling and transport of metal products (Please specify the sources included/excluded in the notes column to the right)										NA	NA	NA	NA	NA		*Amount (kt)*
D_IndProcess	2 D 1	(a)	2 D 1 Pulp and paper	NA	NA						NA		NA	NA	NA	NA	NA		*Pulp production [kt]*
D_IndProcess	2 D 2	(a)	2 D 2 Food and drink	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Bread, Wine, Beer, Spirits Production [kt]*
D_IndProcess	2 D 3		2 D 3 Wood processing	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Please specify*
D_IndProcess	2 E		2 E Production of POPs	NA	NA	NA	NA	NA	NA				NA	NA	NA	NA	NA	*NA*	*NA*
D_IndProcess	2 F		2 F Consumption of POPs and heavy metals (e.g. electricial and scientific equipment)	NA	NA	NA	NA	NA	NA				NA	NA	NA	NA	NA	*NA*	*NA*
D_IndProcess	2 G		2 G Other production, consumption, storage, transportation or handling of bulk products (Please specify the sources included/excluded in the notes column to the right)								NA		NA	NA	NA	NA	NA	*NA*	*NA*
F_Solvents	3 A 1		3 A 1 Decorative coating application	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Solvents used [kt]*
F_Solvents	3 A 2		3 A 2 Industrial coating application	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Solvents used [kt]*
F_Solvents	3 A 3		3 A 3 Other coating application (Please specify the sources included/excluded in the notes column to the right)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Solvents used [kt]*
F_Solvents	3 B 1		3 B 1 Degreasing	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Solvents used [kt]*
F_Solvents	3 B 2		3 B 2 Dry cleaning	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Solvents used [kt]*
F_Solvents	3 C	(a)	3 C Chemical products										NA	NA	NA	NA	NA	*NA*	*Solvents used [kt]*

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AT: 19.12.2012: 2011	***NFR sectors to be reported to LRTAP***				NECD pollutants **Main Pollutants** (from 1980)				**Particulate Matter** (from 2000)			**Other** (from 1980)	**Priority Heavy Metals** (from 1990)			**Other Heavy Metals** (from 1990)					
					NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
NFR Aggregation for Gridding and LPS (GNFR)	***NFR Code***	*annot all*	***Longname***	**Notes:**	**Gg NO_2**	**Gg**	**Gg SO_2**	**Gg**	**Gg**	**Gg**	**Gg**	**Gg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**
F_Solvents	3 D 1		3 D 1 Printing	Default AD-Unit has been	NA	5,96	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 D 2		3 D 2 Domestic solvent use including fungicides		NA	16,92	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F_Solvents	3 D 3		3 D 3 Other product use	Default AD-Unit has been	NA	13,17	NA	NA													
O_AgriLivestock	4 B 1 a	(a)	4 B 1 a Cattle dairy		1,50	NA	NA	15,36				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 1 b	(a)	4 B 1 b Cattle non-dairy		1,91	NA	NA	19,56				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 2	(a)	4 B 2 Buffalo		NO	NO	NO	NO				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 3	(a)	4 B 3 Sheep		0,08	NA	NA	0,17				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 4	(a)	4 B 4 Goats		0,01	NA	NA	0,03													
O_AgriLivestock	4 B 6	(a)	4 B 6 Horses		0,10	NA	NA	0,42				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 7	(a)	4 B 7 Mules and asses		IE	IE	IE	IE				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 8	(a)	4 B 8 Swine		0,79	NA	NA	10,90				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 9 a		4 B 9 a Laying hens		0,15	NA	NA	5,15				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 9 b		4 B 9 b Broilers		IE	IE	IE	IE				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 9 c		4 B 9 c Turkeys		IE	IE	IE	IE				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 9 d		4 B 9 d Other poultry		0,02	NA	NA	0,67				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
O_AgriLivestock	4 B 13	(a)	4 B 13 Other		0,01	NA	NA	0,02				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P_AgriOther	4 D 1 a	(b)	4 D 1 a Synthetic N-fertilizers		1,02	NA	NA	4,36				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P_AgriOther	4 D 2 a		4 D 2 a Farm-level agricultural operations including storage, handling and transport of agricultural products		IE	NA	NA	IE				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P_AgriOther	4 D 2 b		4 D 2 b Off-farm storage, handling and transport of bulk agricultural products		NA	NA	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P_AgriOther	4 D 2 c		4 D 2 c N-excretion on pasture range and paddock unspecified (Please specify the sources included/excluded in the notes column to the right)		IE	NA	NA	1,01				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Q_AgriWastes	4 F	(a)	4 F Field burning of agricultural wastes		0,01	0,08	0,00	0,02													
P_AgriOther	4 G	(a)	4 G Agriculture other(c)		0,05	1,88	NA	0,59													
L_OtherWasteDisp	6 A	(a)	6 A Solid waste disposal on land		NA	0,06	NA	0,00				NA	NA	NA		NA	NA	NA	NA	NA	NA
M_WasteWater	6 B	(a)	6 B Waste-water handling		NA	NA	NA	NA				NA									
N_WasteIncin	6 C a		6 C a Clinical wasteincineration (d)		0,00	0,00	0,00	0,00													
N_WasteIncin	6 C b		6 C b Industrial waste incineration (d)		0,00	0,00	0,01	0,00													

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

AT: 19.12.2012: 2011	***NFR sectors to be reported to LRTAP***			**POPs** $^{(1)}$ (from 1990)									**Activity Data** (From 1990)						
				PCDD/ PCDF (dioxines/ furanes)	PAHs					HCB	HCH	PCBs	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	*Other activity (specified)*	*Other Activity Units*
					benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4										
NFR Aggregation for Gridding and LPS (GNFR)	***NFR Code***	***annot ati***	***Longname***	**g I-Teq**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**kg**	**kg**	**kg**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**	**TJ NCV**		
F_Solvents	3 D 1		3 D 1 Printing	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	*NA*	*Solvents used [kt]*
F_Solvents	3 D 2		3 D 2 Domestic solvent use including fungicides	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Solvents used [kt]*
F_Solvents	3 D 3		3 D 3 Other product use																*Please specify*
O_AgriLivestock	4 B 1 a	(a)	4 B 1 a Cattle dairy	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Population Size (1000 head)*
O_AgriLivestock	4 B 1 b	(a)	4 B 1 b Cattle non-dairy	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Population Size (1000 head)*
O_AgriLivestock	4 B 2	(a)	4 B 2 Buffalo	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Population Size (1000 head)*
O_AgriLivestock	4 B 3	(a)	4 B 3 Sheep	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Population Size (1000 head)*
O_AgriLivestock	4 B 4	(a)	4 B 4 Goats																*Population Size (1000 head)*
O_AgriLivestock	4 B 6	(a)	4 B 6 Horses	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Population Size (1000 head)*
O_AgriLivestock	4 B 7	(a)	4 B 7 Mules and asses	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Population Size (1000 head)*
O_AgriLivestock	4 B 8	(a)	4 B 8 Swine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Population Size (1000 head)*
O_AgriLivestock	4 B 9 a		4 B 9 a Laying hens	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Population Size (1000 head)*
O_AgriLivestock	4 B 9 b		4 B 9 b Broilers	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Population Size (1000 head)*
O_AgriLivestock	4 B 9 c		4 B 9 c Turkeys	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Population Size (1000 head)*
O_AgriLivestock	4 B 9 d		4 B 9 d Other poultry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Population Size (1000 head)*
O_AgriLivestock	4 B 13	(a)	4 B 13 Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Population Size (1000 head)*
P_AgriOther	4 D 1 a	(b)	4 D 1 a Synthetic N-fertilizers	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA		*Use of synthetic fertilizers (kg N/yr)*
P_AgriOther	4 D 2 a		4 D 2 a Farm-level agricultural operations including storage, handling and transport of agricultural products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Please specify*
P_AgriOther	4 D 2 b		4 D 2 b Off-farm storage, handling and transport of bulk agricultural products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Please specify*
P_AgriOther	4 D 2 c		4 D 2 c N-excretion on pasture range and paddock unspecified (Please specify the sources included/excluded in the notes column to the right)	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA		*kg N/yr*
Q_AgriWastes	4 F	(a)	4 F Field burning of agricultural wastes							NA	NA	NA	NA	NA	NA	NA	NA		*Area burned k ha/yr*
P_AgriOther	4 G	(a)	4 G Agriculture other(c)										NA	NA	NA	NA	NA	*NA*	*NA*
L_OtherWasteDisp	6 A	(a)	6 A Solid waste disposal on land	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Annual deposition of MSW at the SWDS [Gg]*
M_WasteWater	6 B	(a)	6 B Waste-water handling	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		*Total organic product [Gg DC/yr]*
N_WasteIncin	6 C a		6 C a Clinical wasteincineration (d)								NA		NA	NA	NA	NA	NA		*Waste incinerated [Gg]*
N_WasteIncin	6 C b		6 C b Industrial waste incineration (d)								NA		NA	NA	NA	NA	NA		*Waste incinerated [Gg]*

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

NECD pollutants

AT: 19.12.2012: 2011	*NFR sectors to be reported to LRTAP*				**Main Pollutants** (from 1980)				**Particulate Matter** (from 2000)			**Other** (from 1980)	**Priority Heavy Metals** (from 1990)			**Other Heavy Metals** (from 1990)					
					NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot ati*	*Longname*	**Notes:**	**Gg NO_2**	**Gg**	**Gg SO_2**	**Gg**	**Gg**	**Gg**	**Gg**	**Gg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**	**Mg**
N_WasteIncin	6 C c		6 C c Municipal waste incineration (d)		NO	NO	NO	NO													
N_WasteIncin	6 C d		6 C d Cremation		0,01	0,00	NA	NA													
N_WasteIncin	6 C e		6 C e Small scale waste burning		IE	IE	IE	IE													
L_OtherWasteDisp	6 D	(a)	6 D Other waste(e)		NA	NA	NA	1,39													
R_Other	7 A	(a)	7 A Other (included in national total for entire territory)		NO	NO	NO	NO													
	NATIONAL TOTAL	(f) (h)	National total for the entire territory		144,21	126,20	18,47	62,12													
	National total (FU)	(h)	National total accounting transport emissions based on fuel used		144,21	126,20	18,47	62,12													
	GRID TOTAL	(g)	National total for the EMEP grid domain																		
	UNFCCC national total		National total as reported under UNFCCC																		
	Memo Items. NOT TO BE INCLUDED IN NATIONAL TOTALS UNLESS OTHERWISE STATED																				
K_CivilAviCruise	1 A 3 a ii (ii)		1 A 3 a ii (ii) Civil aviation (Domestic, Cruise)		0,15	0,01	0,01	0,00													
T_IntAviCruise	1 A 3 a i (ii)		1 A 3 a i (ii) International aviation (Cruise)		7,83	0,50	0,59	0,00													
z_Memo	1 A 3 d i (i)	(a)	1 A 3 d i (i) International maritime navigation		NO	NO	NO	NO													
z_Memo	1 A 3	(i)	Transport (fuel used)		108,13	12,45	0,31	1,09													
z_Memo	7 B		7 B Other not included in nationaltotal of the entire territory (Please specify in notes and your IIR)		NA	NA	NA	NA													
S_Natural	11A		(11 08 Volcanoes)		NO	NO	NO	NO													
S_Natural	11 B		Forest fires		NO	NO	NO	NO													
S_Natural	11 C		Other natural emissions (Please specify in notes and your IIR)		NO	NO	NO	NO													

Table IV 1 (Revised UNECE/EMEP Reporting Guidelines ECE/EB.AIR/97)

AT: 19.12.2012: 2011	NFR sectors to be reported to LRTAP			POPs (1) (from 1990)									Activity Data (From 1990)						
				PCDD/ PCDF (dioxines/ furanes)	PAHs					HCB	HCH	PCBs	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	*Other activity (specified)*	*Other Activity Units*
					benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno (1,2,3-cd) pyrene	Total 1-4										
NFR Aggregation for Gridding and LPS (GNFR)	*NFR Code*	*annot ati*	*Longname*	g I-Teq	Mg	Mg	Mg	Mg	Mg	kg	kg	kg	TJ NCV	TJ NCV	TJ NCV	TJ NCV	TJ NCV		
N_WasteIncin	6 C c		6 C c Municipal waste incineration (d)								NA		NA	NA	NA	NA	NA		*MSW incinerated [Gg]*
N_WasteIncin	6 C d		6 C d Cremation								NA		NA	NA	NA	NA	NA		*Incineration of corpses [Number]*
N_WasteIncin	6 C e		6 C e Small scale waste burning								NA		NA	NA	NA	NA	NA		*Amount of waste burned [kt]*
L_OtherWasteDisp	6 D	(a)	6 D Other waste(e)										NA	NA	NA	NA	NA		*Please specify*
R_Other	7 A	(a)	7 A Other (included in national total for entire territory)										NA	NA	NA	NA	NA	*NA*	*NA*
	NATIONAL TOTAL	(f) (h)	National total for the entire territory										NA	NA	NA	NA	NA	*NA*	*NA*
	National total (FU)	(h)	National total accounting transport emissions based on fuel used										NA	NA	NA	NA	NA	*NA*	*NA*
	GRID TOTAL	(g)	National total for the EMEP grid domain										NA	NA	NA	NA	NA	*NA*	*NA*
	UNFCCC national total		National total as reported under UNFCCC																
	Memo Items. NOT TO BE INCLUDED IN NATIONAL TOTALS UNLESS OTHERWISE ST																		
K_CivilAviCruise	1 A 3 a ii (ii)		1 A 3 a ii (ii) Civil aviation (Domestic, Cruise)							NA	NA	NA		NA	NA	NA	NA	*NA*	*TJ NCV*
T_IntAviCruise	1 A 3 a i (ii)		1 A 3 a i (ii) International aviation (Cruise)							NA	NA	NA		NA	NA	NA	NA	*NA*	*TJ NCV*
z_Memo	1 A 3 d i (i)	(a)	1 A 3 d i (i) International maritime navigation							NA	NA	NA		NA	NA	NA	NA	*NA*	*TJ NCV*
z_Memo	1 A 3	(i)	Transport (fuel used)																
z_Memo	7 B		7 B Other not included in nationaltotal of the entire territory (Please specify in notes and your IIR)							NA	NA	NA	NA	NA	NA	NA	NA	*NA*	*NA*
S_Natural	11A		(11 08 Volcanoes)								NA	NA	NA	NA	NA	NA	NA		*Please specify*
S_Natural	11 B		Forest fires								NA	NA	NA	NA	NA	NA	NA		*Area of forest burned [ha]*
S_Natural	11 C		Other natural emissions (Please specify in notes and your IIR)																

Footnotes to NFR

FOOTNOTES IV 1: National sector emissions: Main pollutants, particulate matter (PM), heavy metals (HM) and persistent organic pollutants (POP).

Table IV 1 F1: Definition of Notation Keys

See: Chapter 1

Table 1 F2: Explanation to the Notation key NE

NFR code	Substance(s)	Reason for reporting NE
1 A 3 a	POPs	No emission factors available. Assumed to be negligible.
2 C 2	Heavy metals, POPS	No emission factors available. Assumed to be negligible.
2 C 5 e	TSP, PM2.5, PM0	No emission factors available. Assumed to be negligible.
3 D 3	POPs	No emission factors available. Assumed to be negligible.

Table IV 1 F3: Explanation to the Notation key IE

NFR code	Substance(s)	Included in NFR code
1 A 1 b	NMVOC	1 B 2 a iv
1 A 3 b vi	TSP, PM2.5, PM0	1 A 3 b vii
1 A 4 a ii	All	1 A 3 b
1 A 5 a	All	1 A 4 a i
1 B 1 b	All	1 A 2 a
1 B 2 c	All	1 A 1 b
2 A 5	NMVOC	3
2 A 6	NMVOC	3
2 A 7 c	TSP, PM2.5, PM0	2 A 7 a
2 B 1	NMVOC	2 B 5 a
2 C 1	NH3	1 A 2 a
4 B 7	NOX, NH3	4 B 6
4 B 9 b	NOX, NH3	4 B 9 d
4 B 9 c	NOX, NH3	4 B 9 d
6 C e	All	1 A 4

Table IV 1 F4: Sub-sources accounted for in reporting codes „other“

NFR code	Substance(s) reported	Sub-source description
1 A 2 f	Main, HM, POPs	Other fuel combustion in industry: ISIC codes according to Guidelines.
1 A 5 a		
1 A 5 b	Main, HM, POPs	Military aviation and road transport
1 B 1 c		NO
1 B 3		NO

2 A 7 d		
2 B 5 a		
2 B 5 b	Main, HM, POPs	Bulk production: Sulphuric acid, Ammonium nitrate, NPK-fertilizers, Urea, Clorine, Ethylene, Phytosanitary, Other anorganic products.
2 C 5 e		Other non ferrous metal production: light alloy casting; Secondary aluminium, copper, lead and zinc production.
2 C 5 f		
2 G		
3 A 3		
4 B 13	NH3, NOX	game animals, mainly deer (pasture)
4 G	NOX, NMVOC, NH3, TSP, PM	Sewage sludge spreading (NOx, NH3). Legumes (NH3). Agricultural vegetation (NMVOC). Animal husbandry (TSP, PM)
6 D		
7 A		
7 B		
11 C		

Table IV 1 F5: Basis for estimating emissions from mobile sources. Please tick off with X.

NFR code	Description	Fuel sold	Fuel used	Comment
1 A 3 a i (i)	International Aviation (LTO)	x		
1 A 3 a i (ii)	International Aviation (Cruise)	x		
1 A 3 a ii (i)	1 A 3 a ii Civil Aviation (Domestic, LTO)	x		
1 A 3 a ii (ii)	1 A 3 a ii Civil Aviation (Domestic, Cruise)	x		
1A3b	Road transport	x		
1A3c	Railways	x		
1A3di (i)	International maritime Navigation	x		
1A3di (ii)	International inland waterways (Included in NEC totals only)	x		
1A3dii	National Navigation	x		
1A4ci	Agriculture	x		
1A4cii	Off-road Vehicles and Other Machinery	x		
1A4ciii	National Fishing	x		
1 A 5 b	Other, Mobile (Including military)	x		

12.2 Emission Trends per Sector - Submission under UNECE/LRTAP

Table A-1: Emission trends for SO_2 [Gg] 1980–2011 – Submission under UNECE/LRTAP.

	NFR-Sectors									
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1980	330.31	327.75	2.56	13.14	NA	0.03	0.41	NO	**343.89**	0.11
1981	288.21	286.31	1.89	13.02	NA	0.03	0.41	NO	**301.66**	0.12
1982	274.02	272.28	1.75	12.89	NA	0.03	0.41	NO	**287.36**	0.11
1983	199.34	197.74	1.59	12.77	NA	0.03	0.41	NO	**212.55**	0.13
1984	182.35	180.68	1.67	12.65	NA	0.03	0.41	NO	**195.45**	0.18
1985	166.62	165.09	1.53	12.07	NA	0.03	0.41	NO	**179.14**	0.20
1986	148.05	146.59	1.46	11.28	NA	0.03	0.41	NO	**159.77**	0.17
1987	127.14	125.61	1.52	10.28	NA	0.03	0.41	NO	**137.86**	0.19
1988	98.63	96.98	1.65	3.92	NA	0.04	0.22	NO	**102.81**	0.21
1989	88.78	87.06	1.73	3.31	NA	0.04	0.14	NO	**92.27**	0.26
1990	72.16	70.16	2.00	2.22	NA	0.00	0.07	NO	**74.45**	0.26
1991	69.61	68.31	1.30	1.90	NA	0.00	0.06	NO	**71.57**	0.29
1992	53.48	51.48	2.00	1.67	NA	0.00	0.04	NO	**55.18**	0.31
1993	52.09	49.99	2.10	1.42	NA	0.00	0.04	NO	**53.55**	0.33
1994	46.47	45.19	1.28	1.42	NA	0.00	0.05	NO	**47.94**	0.34
1995	46.10	44.57	1.53	1.37	NA	0.00	0.05	NO	**47.52**	0.38
1996	43.44	42.24	1.20	1.29	NA	0.00	0.05	NO	**44.78**	0.43
1997	38.92	38.85	0.07	1.27	NA	0.00	0.05	NO	**40.24**	0.44
1998	34.37	34.33	0.04	1.18	NA	0.00	0.05	NO	**35.60**	0.46
1999	32.62	32.48	0.14	1.12	NA	0.00	0.06	NO	**33.79**	0.45
2000	30.57	30.43	0.15	1.09	NA	0.00	0.06	NO	**31.72**	0.48
2001	31.50	31.34	0.16	1.21	NA	0.00	0.06	NO	**32.77**	0.47
2002	29.99	29.85	0.14	1.21	NA	0.00	0.06	NO	**31.26**	0.43
2003	30.71	30.56	0.15	1.21	NA	0.00	0.06	NO	**31.98**	0.40
2004	26.16	26.02	0.14	1.22	NA	0.00	0.06	NO	**27.44**	0.47
2005	25.87	25.74	0.13	1.22	NA	0.00	0.06	NO	**27.15**	0.55
2006	26.55	26.39	0.17	1.22	NA	0.00	0.05	NO	**27.82**	0.58
2007	23.11	22.93	0.18	1.22	NA	0.00	0.04	NO	**24.38**	0.61
2008	20.74	20.58	0.16	1.23	NA	0.00	0.03	NO	**22.00**	0.61
2009	16.51	16.27	0.24	1.21	NA	0.00	0.02	NO	**17.73**	0.53
2010	17.63	17.40	0.23	1.21	NA	0.00	0.01	NO	**18.85**	0.57
2011	17.28	17.05	0.23	1.22	NA	0.00	0.01	NO	**18.51**	0.60

Table A-2: Emission trends for NO_x [Gg] 1980–2011 – Submission under UNECE/LRTAP.

	NFR-Sectors									
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTIO N ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTU RE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1980	209.50	209.50	IE	13.98	NA	7.20	0.25	NO	**230.94**	1.01
1981	197.09	197.09	IE	12.71	NA	7.19	0.25	NO	**217.24**	1.10
1982	194.91	194.91	IE	11.45	NA	7.32	0.25	NO	**213.94**	1.02
1983	197.95	197.95	IE	10.27	NA	7.45	0.25	NO	**215.92**	1.27
1984	199.55	199.55	IE	9.07	NA	7.59	0.25	NO	**216.47**	1.71
1985	205.31	205.31	IE	7.88	NA	7.53	0.25	NO	**220.97**	1.86
1986	199.04	199.04	IE	6.68	NA	7.38	0.25	NO	**213.36**	1.64
1987	195.21	195.21	IE	5.49	NA	7.62	0.25	NO	**208.57**	1.82
1988	190.92	190.92	IE	5.27	NA	7.52	0.17	NO	**203.88**	2.00
1989	185.39	185.39	IE	4.99	NA	7.26	0.13	NO	**197.78**	2.46
1990	184.06	184.06	IE	4.80	NA	6.51	0.10	NO	**195.47**	2.44
1991	191.40	191.40	IE	4.48	NA	6.70	0.09	NO	**202.67**	2.76
1992	182.12	182.12	IE	4.55	NA	6.32	0.06	NO	**193.05**	3.00
1993	179.56	179.56	IE	1.98	NA	6.11	0.05	NO	**187.70**	3.18
1994	173.45	173.45	IE	1.92	NA	6.53	0.04	NO	**181.95**	3.31
1995	173.79	173.79	IE	1.46	NA	6.66	0.05	NO	**181.95**	3.73
1996	196.20	196.20	IE	1.42	NA	6.32	0.05	NO	**203.99**	4.14
1997	184.11	184.11	IE	1.50	NA	6.32	0.05	NO	**191.98**	4.29
1998	198.08	198.08	IE	1.46	NA	6.33	0.05	NO	**205.92**	4.43
1999	191.12	191.12	IE	1.44	NA	6.17	0.05	NO	**198.78**	4.33
2000	198.71	198.71	IE	1.54	NA	6.05	0.05	NO	**206.35**	6.44
2001	208.82	208.82	IE	1.57	NA	6.02	0.05	NO	**216.47**	6.32
2002	215.22	215.22	IE	1.63	NA	5.95	0.05	NO	**222.86**	5.67
2003	227.06	227.06	IE	1.34	NA	5.83	0.05	NO	**234.28**	5.21
2004	226.15	226.15	IE	1.28	NA	5.67	0.05	NO	**233.15**	6.09
2005	230.07	230.07	IE	1.75	NA	5.64	0.05	NO	**237.52**	6.99
2006	215.64	215.64	IE	1.82	NA	5.65	0.04	NO	**223.15**	7.54
2007	209.48	209.48	IE	1.71	NA	5.72	0.04	NO	**216.95**	7.99
2008	197.05	197.05	IE	1.59	NA	5.82	0.03	NO	**204.49**	7.90
2009	181.77	181.77	IE	1.26	NA	5.80	0.02	NO	**188.85**	6.86
2010	186.07	186.07	IE	1.50	NA	5.59	0.01	NO	**193.16**	7.60
2011	175.53	175.53	IE	1.50	NA	5.66	0.01	NO	**182.71**	7.98

Table A-3: Emission trends for NMVOC [Gg] 1980–2011 – Submission under UNECE/LRTAP.

	NFR-Sectors									
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1980	163.54	150.29	13.24	17.73	206.56	4.55	0.16	NO	**392.54**	0.07
1981	165.91	153.12	12.78	17.12	182.78	4.48	0.16	NO	**370.45**	0.08
1982	165.90	153.78	12.12	16.76	180.30	4.60	0.16	NO	**367.73**	0.08
1983	167.63	155.74	11.89	16.24	177.85	4.51	0.16	NO	**366.39**	0.09
1984	172.40	160.39	12.01	15.73	175.43	4.57	0.16	NO	**368.29**	0.13
1985	172.46	160.39	12.07	15.21	172.64	4.61	0.16	NO	**365.07**	0.14
1986	167.33	155.21	12.12	14.83	172.26	4.52	0.16	NO	**359.09**	0.12
1987	165.48	153.24	12.24	14.36	171.88	4.54	0.16	NO	**356.42**	0.14
1988	155.54	143.52	12.02	14.57	171.48	4.66	0.16	NO	**346.41**	0.15
1989	149.96	137.72	12.24	14.54	149.04	4.61	0.16	NO	**318.32**	0.18
1990	146.30	133.68	12.62	11.10	114.43	1.85	0.16	NO	**273.84**	0.18
1991	153.35	139.87	13.48	12.58	96.93	1.85	0.16	NO	**264.86**	0.20
1992	145.18	131.82	13.36	13.78	78.54	1.79	0.15	NO	**239.44**	0.22
1993	142.64	129.56	13.08	15.05	79.91	1.76	0.14	NO	**239.51**	0.24
1994	132.28	121.88	10.40	13.57	75.02	1.81	0.13	NO	**222.82**	0.25
1995	127.37	118.43	8.94	11.95	81.27	1.82	0.13	NO	**222.54**	0.29
1996	123.82	115.84	7.97	10.37	77.47	1.80	0.12	NO	**213.58**	0.34
1997	104.76	97.33	7.43	9.06	83.48	1.88	0.11	NO	**199.31**	0.37
1998	99.09	93.18	5.91	7.71	75.46	1.84	0.11	NO	**184.22**	0.40
1999	93.25	88.07	5.18	6.04	69.41	1.88	0.10	NO	**170.68**	0.39
2000	86.30	81.08	5.22	4.96	82.35	1.79	0.10	NO	**175.49**	0.42
2001	82.36	79.01	3.35	4.38	86.90	1.86	0.10	NO	**175.60**	0.41
2002	78.09	74.55	3.54	4.57	92.50	1.86	0.10	NO	**177.12**	0.37
2003	75.61	72.16	3.45	4.26	93.44	1.73	0.10	NO	**175.14**	0.34
2004	70.74	67.65	3.09	4.40	79.42	1.98	0.09	NO	**156.63**	0.40
2005	68.85	65.99	2.86	4.71	89.20	1.86	0.09	NO	**164.71**	0.47
2006	62.85	59.96	2.88	4.87	105.01	1.79	0.08	NO	**174.60**	0.50
2007	58.62	56.13	2.49	4.89	95.52	1.79	0.08	NO	**160.90**	0.53
2008	56.37	54.12	2.25	4.80	88.24	1.95	0.07	NO	**151.42**	0.52
2009	51.95	49.84	2.11	4.52	64.27	1.83	0.07	NO	**122.63**	0.45
2010	53.66	51.66	2.00	4.69	74.09	1.78	0.06	NO	**134.28**	0.49
2011	48.71	46.79	1.93	4.91	72.53	1.95	0.06	NO	**128.17**	0.51

Table A-4: Emission trends for NH_3 [Gg] 1980–2011 – Submission under UNECE/LRTAP.

NFR-Sectors										
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1980	1.515	1.515	IE	0.307	NA	61.229	0.007	NO	**63.058**	0.001
1981	1.415	1.415	IE	0.297	NA	62.738	0.007	NO	**64.457**	0.001
1982	1.394	1.394	IE	0.288	NA	62.867	0.007	NO	**64.556**	0.001
1983	1.369	1.369	IE	0.278	NA	63.776	0.007	NO	**65.430**	0.001
1984	1.407	1.407	IE	0.286	NA	64.716	0.007	NO	**66.416**	0.001
1985	1.443	1.443	IE	0.277	NA	63.817	0.007	NO	**65.543**	0.001
1986	1.455	1.455	IE	0.256	NA	63.105	0.007	NO	**64.823**	0.001
1987	1.448	1.448	IE	0.262	NA	63.754	0.007	NO	**65.471**	0.001
1988	2.209	2.209	IE	0.283	NA	62.387	0.006	NO	**64.885**	0.001
1989	3.182	3.182	IE	0.270	NA	61.658	0.006	NO	**65.115**	0.002
1990	4.054	4.054	IE	0.269	NA	60.704	0.358	NO	**65.386**	0.002
1991	5.660	5.660	IE	0.507	NA	61.375	0.371	NO	**67.913**	0.002
1992	6.576	6.576	IE	0.369	NA	59.554	0.421	NO	**66.920**	0.002
1993	7.486	7.486	IE	0.219	NA	60.037	0.498	NO	**68.240**	0.002
1994	8.160	8.160	IE	0.168	NA	61.085	0.572	NO	**69.985**	0.002
1995	7.996	7.996	IE	0.099	NA	62.067	0.584	NO	**70.746**	0.003
1996	7.530	7.530	IE	0.097	NA	60.447	0.605	NO	**68.679**	0.003
1997	6.985	6.985	IE	0.103	NA	61.101	0.586	NO	**68.775**	0.003
1998	7.010	7.010	IE	0.103	NA	61.478	0.603	NO	**69.194**	0.003
1999	6.312	6.312	IE	0.119	NA	60.012	0.638	NO	**67.080**	0.003
2000	5.790	5.790	IE	0.100	NA	58.106	0.663	NO	**64.659**	0.003
2001	5.615	5.615	IE	0.079	NA	58.094	0.739	NO	**64.527**	0.003
2002	5.532	5.532	IE	0.061	NA	57.340	0.814	NO	**63.746**	0.003
2003	5.349	5.349	IE	0.076	NA	57.361	0.885	NO	**63.671**	0.003
2004	4.856	4.856	IE	0.059	NA	56.844	1.168	NO	**62.926**	0.003
2005	4.505	4.505	IE	0.068	NA	56.856	1.291	NO	**62.720**	0.004
2006	3.950	3.950	IE	0.074	NA	57.229	1.355	NO	**62.608**	0.004
2007	3.621	3.621	IE	0.077	NA	58.366	1.400	NO	**63.463**	0.004
2008	3.214	3.214	IE	0.081	NA	58.027	1.372	NO	**62.695**	0.004
2009	2.867	2.867	IE	0.088	NA	59.105	1.362	NO	**63.423**	0.004
2010	2.877	2.877	IE	0.091	NA	58.834	1.393	NO	**63.194**	0.004
2011	2.591	2.591	IE	0.101	NA	58.247	1.396	NO	**62.334**	0.004

Table A-5: Emission trends for CO [Gg] 1980–2011 – Submission under UNECE/LRTAP.

	NFR-Sectors									
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1980	1 719.26	1 719.26	IE	52.80	NA	23.80	10.59	NO	**1 806.46**	0.20
1981	1 711.96	1 711.96	IE	50.65	NA	20.50	10.60	NO	**1 793.71**	0.22
1982	1 720.21	1 720.21	IE	48.26	NA	23.96	10.64	NO	**1 803.08**	0.20
1983	1 709.22	1 709.22	IE	47.85	NA	24.62	10.59	NO	**1 792.29**	0.25
1984	1 758.49	1 758.49	IE	48.06	NA	26.35	10.59	NO	**1 843.49**	0.34
1985	1 730.60	1 730.60	IE	46.71	NA	26.23	10.56	NO	**1 814.10**	0.37
1986	1 669.11	1 669.11	IE	44.69	NA	23.21	10.43	NO	**1 747.44**	0.33
1987	1 602.61	1 602.61	IE	44.95	NA	24.06	10.45	NO	**1 682.06**	0.36
1988	1 520.58	1 520.58	IE	45.92	NA	27.78	10.69	NO	**1 604.97**	0.40
1989	1 494.47	1 494.47	IE	46.27	NA	27.27	11.07	NO	**1 579.07**	0.49
1990	1 377.87	1 377.87	IE	46.37	NA	0.99	11.16	NO	**1 436.40**	0.49
1991	1 446.72	1 446.72	IE	41.67	NA	0.96	11.12	NO	**1 500.47**	0.55
1992	1 414.79	1 414.79	IE	44.97	NA	0.98	10.77	NO	**1 471.51**	0.59
1993	1 381.04	1 381.04	IE	47.15	NA	0.87	10.59	NO	**1 439.65**	0.63
1994	1 326.86	1 326.86	IE	48.65	NA	0.96	9.99	NO	**1 386.45**	0.66
1995	1 218.10	1 218.10	IE	45.08	NA	0.95	9.41	NO	**1 273.54**	0.75
1996	1 199.12	1 199.12	IE	39.44	NA	0.89	8.88	NO	**1 248.32**	0.84
1997	1 103.60	1 103.60	IE	38.30	NA	0.94	8.43	NO	**1 151.28**	0.89
1998	1 065.80	1 065.80	IE	34.86	NA	0.92	8.09	NO	**1 109.68**	0.93
1999	992.41	992.41	IE	30.58	NA	0.95	7.73	NO	**1 031.68**	0.89
2000	922.76	922.76	IE	27.38	NA	0.82	7.40	NO	**958.37**	0.80
2001	887.54	887.54	IE	24.20	NA	0.94	7.12	NO	**919.80**	0.78
2002	852.28	852.28	IE	23.87	NA	0.89	7.16	NO	**884.20**	0.66
2003	845.53	845.53	IE	23.59	NA	0.82	7.30	NO	**877.25**	0.65
2004	807.54	807.54	IE	23.86	NA	1.31	6.83	NO	**839.53**	0.73
2005	782.93	782.93	IE	24.23	NA	0.79	6.42	NO	**814.36**	0.91
2006	742.48	742.48	IE	24.51	NA	0.73	6.11	NO	**773.83**	0.92
2007	690.86	690.86	IE	24.70	NA	0.74	5.73	NO	**722.03**	0.96
2008	653.38	653.38	IE	24.51	NA	0.74	5.29	NO	**683.92**	0.96
2009	608.65	608.65	IE	23.42	NA	0.69	4.90	NO	**637.65**	0.82
2010	615.69	615.69	IE	23.86	NA	0.65	4.54	NO	**644.73**	0.87
2011	580.11	580.11	IE	23.95	NA	0.50	4.21	NO	**608.77**	0.86

Table A-6: Emission trends for Cd [kg] 1985–2011 – Submission under UNECE/LRTAP.

	NFR-Sectors									
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1985	2 093.3	2 093.3	NA	837.1	0.2	32.4	138.3	NO	**3 101.3**	0.2
1986	1 832.7	1 832.7	NA	709.6	0.2	28.7	121.4	NO	**2 692.6**	0.2
1987	1 418.4	1 418.4	NA	654.0	0.2	29.7	104.6	NO	**2 206.9**	0.2
1988	1 200.0	1 200.0	NA	619.6	0.2	34.2	77.8	NO	**1 931.8**	0.2
1989	1 063.6	1 063.6	NA	580.8	0.2	33.6	61.1	NO	**1 739.4**	0.2
1990	1 065.9	1 065.9	NA	456.6	0.2	1.9	59.2	NO	**1 583.7**	0.2
1991	1 097.7	1 097.7	NA	384.5	0.2	1.9	48.4	NO	**1 532.8**	0.3
1992	981.8	981.8	NA	263.9	0.2	1.9	5.3	NO	**1 253.1**	0.3
1993	945.7	945.7	NA	215.6	0.2	1.8	4.6	NO	**1 167.9**	0.3
1994	884.4	884.4	NA	177.5	0.2	1.9	3.9	NO	**1 067.8**	0.3
1995	814.7	814.7	NA	159.7	0.2	1.8	1.9	NO	**978.3**	0.3
1996	849.0	849.0	NA	146.9	0.2	1.8	1.8	NO	**999.6**	0.4
1997	802.9	802.9	NA	162.9	0.2	1.8	1.8	NO	**969.6**	0.4
1998	735.9	735.9	NA	160.4	0.2	1.8	1.7	NO	**899.9**	0.4
1999	776.3	776.3	NA	167.7	0.2	1.8	1.7	NO	**947.6**	0.4
2000	736.9	736.9	NA	182.8	0.2	1.6	1.6	NO	**923.2**	0.4
2001	766.3	766.3	NA	179.5	0.2	1.8	1.6	NO	**949.3**	0.4
2002	741.4	741.4	NA	189.5	0.2	1.7	1.6	NO	**934.4**	0.4
2003	778.3	778.3	NA	190.2	0.2	1.6	1.6	NO	**971.9**	0.3
2004	774.0	774.0	NA	197.9	0.2	2.2	1.6	NO	**975.8**	0.4
2005	845.9	845.9	NA	218.1	0.2	1.6	1.5	NO	**1 067.3**	0.5
2006	831.4	831.4	NA	222.2	0.2	1.5	1.3	NO	**1 056.7**	0.5
2007	851.0	851.0	NA	235.2	0.2	1.5	1.2	NO	**1 089.1**	0.5
2008	880.0	880.0	NA	234.3	0.2	1.5	1.0	NO	**1 117.1**	0.5
2009	875.9	875.9	NA	173.3	0.2	1.5	0.9	NO	**1 051.7**	0.5
2010	959.3	959.3	NA	223.1	0.2	1.4	0.7	NO	**1 184.7**	0.5
2011	928.8	928.8	NA	230.2	0.2	1.2	0.7	NO	**1 161.1**	0.5

Table A-7: Emission trends for Hg [kg] 1985–2011 – Submission under UNECE/LRTAP.

	NFR-Sectors									
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1985	2 982.3	2 982.3	NA	670.6	NA	5.8	86.1	NO	**3 744.8**	0.1
1986	2 603.8	2 603.8	NA	629.1	NA	5.1	78.8	NO	**3 316.8**	0.1
1987	2 159.1	2 159.1	NA	606.6	NA	5.3	71.5	NO	**2 842.5**	0.1
1988	1 782.5	1 782.5	NA	593.6	NA	6.1	63.7	NO	**2 445.9**	0.1
1989	1 592.5	1 592.5	NA	579.4	NA	6.0	57.3	NO	**2 235.2**	0.1
1990	1 562.3	1 562.3	NA	527.6	NA	0.3	53.6	NO	**2 143.8**	0.1
1991	1 502.1	1 502.1	NA	492.2	NA	0.3	45.5	NO	**2 040.1**	0.1
1992	1 183.3	1 183.3	NA	435.4	NA	0.3	23.9	NO	**1 642.9**	0.1
1993	958.8	958.8	NA	412.0	NA	0.3	22.8	NO	**1 393.9**	0.1
1994	761.3	761.3	NA	398.1	NA	0.3	21.4	NO	**1 181.1**	0.1
1995	715.1	715.1	NA	466.2	NA	0.3	20.3	NO	**1 201.8**	0.1
1996	711.1	711.1	NA	430.8	NA	0.3	18.3	NO	**1 160.4**	0.1
1997	682.9	682.9	NA	433.6	NA	0.3	16.1	NO	**1 132.8**	0.1
1998	601.1	601.1	NA	333.5	NA	0.3	14.0	NO	**948.8**	0.1
1999	645.5	645.5	NA	275.9	NA	0.3	12.1	NO	**933.8**	0.1
2000	638.2	638.2	NA	241.4	NA	0.2	10.0	NO	**889.9**	0.1
2001	698.7	698.7	NA	244.9	NA	0.3	9.8	NO	**953.6**	0.1
2002	645.2	645.2	NA	260.9	NA	0.3	9.9	NO	**916.3**	0.1
2003	681.0	681.0	NA	261.4	NA	0.2	14.6	NO	**957.3**	0.1
2004	638.4	638.4	NA	271.7	NA	0.3	19.3	NO	**929.7**	0.1
2005	670.1	670.1	NA	304.8	NA	0.2	20.6	NO	**995.7**	0.2
2006	675.6	675.6	NA	310.7	NA	0.2	20.5	NO	**1 007.0**	0.2
2007	659.7	659.7	NA	328.8	NA	0.2	20.3	NO	**1 009.0**	0.2
2008	679.1	679.1	NA	326.5	NA	0.2	20.2	NO	**1 026.0**	0.2
2009	632.2	632.2	NA	244.4	NA	0.2	20.1	NO	**896.9**	0.2
2010	674.3	674.3	NA	315.1	NA	0.2	19.9	NO	**1 009.5**	0.2
2011	659.8	659.8	NA	325.0	NA	0.2	19.9	NO	**1 004.9**	0.2

Table A-8: Emission trends for Pb [kg] 1985–2011 – Submission under UNECE/LRTAP.

	NFR-Sectors									
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTUR E**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1985	257 494.7	257 494.7	NA	62 447.2	20.0	173.7	5 845.7	NO	**325 981.4**	0.2
1986	254 288.9	254 288.9	NA	52 375.3	20.0	153.9	5 268.9	NO	**312 107.1**	0.2
1987	253 264.4	253 264.4	NA	47 854.7	20.0	159.2	4 692.2	NO	**305 990.5**	0.2
1988	227 578.5	227 578.5	NA	45 156.6	20.0	183.2	2 591.4	NO	**275 529.7**	0.2
1989	198 447.0	198 447.0	NA	41 738.3	20.0	180.2	1 638.2	NO	**242 023.7**	0.2
1990	185 819.1	185 819.1	NA	32 092.8	20.0	11.4	1 015.8	NO	**218 959.0**	0.2
1991	151 982.9	151 982.9	NA	27 091.3	20.0	11.2	777.6	NO	**179 883.0**	0.3
1992	105 731.6	105 731.6	NA	18 609.2	20.0	11.3	488.3	NO	**124 860.4**	0.3
1993	71 859.7	71 859.7	NA	15 146.0	20.0	10.5	381.1	NO	**87 417.3**	0.3
1994	47 578.4	47 578.4	NA	12 025.4	20.0	11.0	265.7	NO	**59 900.5**	0.3
1995	11 362.0	11 362.0	NA	4 680.1	20.0	10.8	9.2	NO	**16 082.1**	0.3
1996	11 223.7	11 223.7	NA	4 260.7	20.0	10.4	9.1	NO	**15 523.9**	0.4
1997	9 631.9	9 631.9	NA	4 791.8	20.0	10.5	9.0	NO	**14 463.3**	0.4
1998	8 237.3	8 237.3	NA	4 703.5	20.0	10.4	9.0	NO	**12 980.2**	0.4
1999	7 480.9	7 480.9	NA	4 906.9	20.0	10.5	9.0	NO	**12 427.3**	0.4
2000	6 389.0	6 389.0	NA	5 481.3	20.0	9.6	8.9	NO	**11 908.9**	0.4
2001	6 639.6	6 639.6	NA	5 350.9	20.0	10.4	8.9	NO	**12 029.8**	0.4
2002	6 475.4	6 475.4	NA	5 649.8	20.0	10.0	8.9	NO	**12 164.2**	0.4
2003	6 749.5	6 749.5	NA	5 676.3	20.0	9.3	8.9	NO	**12 463.9**	0.3
2004	6 868.5	6 868.5	NA	5 899.5	20.0	12.4	8.8	NO	**12 809.3**	0.4
2005	7 097.0	7 097.0	NA	6 493.6	20.0	9.3	8.8	NO	**13 628.7**	0.5
2006	7 045.0	7 045.0	NA	6 608.5	20.0	8.9	7.2	NO	**13 689.6**	0.5
2007	7 350.7	7 350.7	NA	7 000.6	20.0	9.0	5.9	NO	**14 386.2**	0.5
2008	7 710.4	7 710.4	NA	6 975.5	20.0	9.0	4.5	NO	**14 719.5**	0.5
2009	7 415.3	7 415.3	NA	5 157.5	20.0	8.7	3.2	NO	**12 604.6**	0.5
2010	8 674.6	8 674.6	NA	6 646.1	20.0	8.1	1.9	NO	**15 350.7**	0.5
2011	8 530.1	8 530.1	NA	6 859.9	20.0	7.2	1.8	NO	**15 418.9**	0.5

Table A-9: Emission trends for PAH [kg] 1985–2011 – Submission under UNECE/LRTAP.

	NFR-Sectors									
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1985	11 953.2	11 953.2	NA	7 268.4	151.7	7 065.8	0.33	NO	**26 439.5**	NE
1986	11 295.6	11 295.6	NA	7 092.2	151.7	7 062.9	0.33	NO	**25 602.8**	NE
1987	11 120.7	11 120.7	NA	7 123.3	151.7	7 062.9	0.33	NO	**25 458.9**	NE
1988	10 008.2	10 008.2	NA	7 308.6	151.7	7 062.9	0.26	NO	**24 531.7**	NE
1989	9 511.3	9 511.3	NA	7 260.7	151.7	7 062.9	0.23	NO	**23 986.9**	NE
1990	9 535.1	9 535.1	NA	6 982.4	151.7	249.8	0.25	NO	**16 919.3**	NE
1991	10 377.7	10 377.7	NA	6 780.5	151.7	249.8	0.24	NO	**17 560.0**	NE
1992	9 453.5	9 453.5	NA	2 974.0	109.5	249.8	0.02	NO	**12 786.7**	NE
1993	9 326.0	9 326.0	NA	441.3	73.9	248.5	0.02	NO	**10 089.6**	NE
1994	8 431.0	8 431.0	NA	345.4	55.8	248.5	0.02	NO	**9 080.7**	NE
1995	8 888.4	8 888.4	NA	252.0	35.9	246.7	0.02	NO	**9 423.0**	NE
1996	9 601.0	9 601.0	NA	235.1	15.0	246.7	0.02	NO	**10 097.9**	NE
1997	8 607.3	8 607.3	NA	215.0	6.8	243.2	0.02	NO	**9 072.4**	NE
1998	8 327.5	8 327.5	NA	195.3	NE	243.2	0.02	NO	**8 765.9**	NE
1999	8 323.8	8 323.8	NA	197.4	NE	241.7	0.02	NO	**8 762.9**	NE
2000	7 792.4	7 792.4	NA	179.1	NE	241.7	0.02	NO	**8 213.2**	NE
2001	8 203.7	8 203.7	NA	181.1	NE	241.7	0.02	NO	**8 626.5**	NE
2002	7 762.9	7 762.9	NA	190.3	NE	241.7	0.02	NO	**8 194.9**	NE
2003	7 795.6	7 795.6	NA	190.7	NE	237.6	0.03	NO	**8 223.9**	NE
2004	7 845.8	7 845.8	NA	196.9	NE	304.1	0.03	NO	**8 346.8**	NE
2005	8 475.5	8 475.5	NA	216.1	NE	207.6	0.03	NO	**8 899.2**	NE
2006	7 580.3	7 580.3	NA	219.7	NE	197.1	0.02	NO	**7 997.1**	NE
2007	7 415.1	7 415.1	NA	230.4	NE	205.2	0.02	NO	**7 850.7**	NE
2008	7 436.0	7 436.0	NA	229.1	NE	181.4	0.02	NO	**7 846.6**	NE
2009	7 011.4	7 011.4	NA	181.0	NE	183.5	0.01	NO	**7 375.9**	NE
2010	7 706.2	7 706.2	NA	222.1	NE	172.2	0.01	NO	**8 100.4**	NE
2011	6 678.7	6 678.7	NA	228.1	NE	119.6	0.01	NO	**7 026.4**	NE

Table A-10: Emission trends for Dioxin/Furan (PCDD/F) [g] 1985–2011 – Submission under UNECE/LRTAP.

	NFR-Sectors									
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1985	109.70	109.70	NA	51.30	5.19	5.05	15.90	NO	**187.14**	NE
1986	107.88	107.88	NA	51.02	6.20	5.05	15.89	NO	**186.05**	NE
1987	116.05	116.05	NA	50.81	0.24	5.05	15.89	NO	**188.04**	NE
1988	110.18	110.18	NA	41.60	1.06	5.05	15.48	NO	**173.37**	NE
1989	101.90	101.90	NA	41.13	1.06	5.05	15.29	NO	**164.43**	NE
1990	102.32	102.32	NA	39.00	1.06	0.18	18.19	NO	**160.76**	NE
1991	81.34	81.34	NA	35.15	1.04	0.18	17.75	NO	**135.47**	NE
1992	54.30	54.30	NA	21.89	0.02	0.18	0.53	NO	**76.92**	NE
1993	49.69	49.69	NA	17.01	0.02	0.18	0.22	NO	**67.12**	NE
1994	44.83	44.83	NA	11.26	NE	0.18	0.08	NO	**56.36**	NE
1995	46.09	46.09	NA	12.23	NE	0.18	0.08	NO	**58.58**	NE
1996	48.50	48.50	NA	11.17	NE	0.18	0.08	NO	**59.93**	NE
1997	46.99	46.99	NA	12.15	NE	0.18	0.08	NO	**59.40**	NE
1998	44.59	44.59	NA	11.45	NE	0.18	0.08	NO	**56.30**	NE
1999	40.80	40.80	NA	12.60	NE	0.18	0.08	NO	**53.65**	NE
2000	37.75	37.75	NA	14.05	NE	0.18	0.08	NO	**52.06**	NE
2001	39.20	39.20	NA	13.55	NE	0.18	0.08	NO	**53.01**	NE
2002	36.42	36.42	NA	3.24	NE	0.18	0.08	NO	**39.92**	NE
2003	36.19	36.19	NA	2.98	NE	0.17	0.12	NO	**39.46**	NE
2004	36.29	36.29	NA	3.30	NE	0.22	0.16	NO	**39.97**	NE
2005	38.66	38.66	NA	4.02	NE	0.15	0.17	NO	**43.00**	NE
2006	34.71	34.71	NA	4.76	NE	0.15	0.17	NO	**39.78**	NE
2007	34.05	34.05	NA	4.08	NE	0.15	0.17	NO	**38.45**	NE
2008	34.71	34.71	NA	3.54	NE	0.13	0.17	NO	**38.55**	NE
2009	32.45	32.45	NA	2.73	NE	0.14	0.17	NO	**35.48**	NE
2010	36.36	36.36	NA	3.35	NE	0.13	0.16	NO	**40.01**	NE
2011	32.04	32.04	NA	3.15	NE	0.09	0.16	NO	**35.45**	NE

Table A-11: Emission trends for HCB [kg] 1985–2011 – Submission under UNECE/LRTAP.

	NFR-Sectors									
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1985	83.216	83.216	NA	13.269	7.708	1.011	1.113	NO	**106.317**	NE
1986	80.311	80.311	NA	13.215	8.118	1.010	1.112	NO	**103.766**	NE
1987	83.160	83.160	NA	13.181	8.113	1.010	1.111	NO	**106.576**	NE
1988	76.982	76.982	NA	11.160	8.218	1.010	0.704	NO	**98.074**	NE
1989	72.906	72.906	NA	11.064	9.342	1.010	0.519	NO	**94.841**	NE
1990	72.762	72.762	NA	9.712	9.053	0.037	0.392	NO	**91.956**	NE
1991	69.902	69.902	NA	8.032	6.392	0.037	0.275	NO	**84.637**	NE
1992	57.132	57.132	NA	4.941	7.491	0.037	0.106	NO	**69.708**	NE
1993	53.769	53.769	NA	3.702	6.473	0.037	0.045	NO	**64.025**	NE
1994	48.196	48.196	NA	2.453	1.252	0.037	0.017	NO	**51.956**	NE
1995	50.380	50.380	NA	2.670	0.003	0.036	0.017	NO	**53.106**	NE
1996	53.322	53.322	NA	2.440	0.003	0.036	0.017	NO	**55.818**	NE
1997	49.212	49.212	NA	2.655	0.003	0.036	0.017	NO	**51.923**	NE
1998	46.612	46.612	NA	2.500	0.003	0.036	0.017	NO	**49.167**	NE
1999	44.761	44.761	NA	2.756	0.003	0.036	0.017	NO	**47.572**	NE
2000	41.114	41.114	NA	3.074	0.004	0.036	0.017	NO	**44.244**	NE
2001	42.758	42.758	NA	2.978	0.004	0.036	0.016	NO	**45.792**	NE
2002	38.759	38.759	NA	3.170	NE	0.036	0.016	NO	**41.981**	NE
2003	37.645	37.645	NA	3.178	NE	0.035	0.024	NO	**40.882**	NE
2004	37.410	37.410	NA	3.301	NE	0.044	0.032	NO	**40.787**	NE
2005	41.702	41.702	NA	3.691	NE	0.031	0.034	NO	**45.459**	NE
2006	38.088	38.088	NA	3.762	NE	0.029	0.034	NO	**41.913**	NE
2007	36.801	36.801	NA	3.979	NE	0.030	0.034	NO	**40.844**	NE
2008	37.299	37.299	NA	3.953	NE	0.027	0.034	NO	**41.313**	NE
2009	35.152	35.152	NA	2.964	NE	0.027	0.033	NO	**38.177**	NE
2010	39.630	39.630	NA	3.814	NE	0.025	0.033	NO	**43.502**	NE
2011	33.456	33.456	NA	3.934	NE	0.018	0.033	NO	**37.441**	NE

Table A-12: Emission trends for TSP [Mg] 1990–2011 – Submission under UNECE/LRTAP.

NFR-Sectors										
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1990	30 699	30 036	663	18 539	407	12 738	146	NO	**62 528**	280
1995	31 392	30 834	558	18 633	421	12 558	159	NO	**63 164**	416
2000	31 658	31 086	572	18 771	425	12 367	91	NO	**63 312**	524
2001	32 099	31 499	600	18 116	426	12 376	87	NO	**63 104**	512
2002	31 828	31 214	614	17 409	428	12 344	110	NO	**62 119**	462
2003	32 345	31 688	657	17 148	430	12 412	130	NO	**62 465**	428
2004	32 294	31 678	616	17 841	433	12 441	169	NO	**63 178**	506
2005	33 306	32 681	626	17 229	436	12 223	189	NO	**63 383**	594
2006	32 571	31 965	606	16 086	438	12 195	186	NO	**61 476**	626
2007	32 379	31 832	547	15 724	440	12 086	216	NO	**60 845**	663
2008	32 389	31 867	522	16 872	442	12 033	179	NO	**61 915**	662
2009	31 131	30 733	398	15 654	443	12 037	170	NO	**59 435**	570
2010	32 119	31 640	479	15 394	445	12 040	199	NO	**60 197**	622
2011	31 310	30 819	491	15 854	446	12 012	228	NO	**59 850**	648

Table A-13: Emission trends for PM10 [Mg] 1990–2011 – Submission under UNECE/LRTAP.

	NFR-Sectors									
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1990	23 016	22 704	312	10 450	407	5 809	70	NO	**39 751**	280
1995	22 992	22 729	263	9 967	421	5 724	76	NO	**39 180**	416
2000	22 591	22 321	270	9 915	425	5 630	43	NO	**38 604**	524
2001	22 926	22 644	283	9 598	426	5 640	41	NO	**38 632**	512
2002	22 580	22 291	290	8 911	428	5 623	52	NO	**37 595**	462
2003	22 894	22 584	310	8 783	430	5 649	61	NO	**37 817**	428
2004	22 675	22 384	291	9 076	433	5 688	80	NO	**37 952**	506
2005	23 322	23 026	295	8 741	436	5 563	90	NO	**38 151**	594
2006	22 355	22 069	286	8 024	438	5 547	88	NO	**36 452**	626
2007	21 987	21 728	259	7 706	440	5 499	102	NO	**35 734**	663
2008	21 874	21 628	247	8 300	442	5 475	85	NO	**36 176**	662
2009	20 858	20 670	188	7 679	443	5 474	80	NO	**34 535**	570
2010	21 633	21 406	227	7 552	445	5 472	94	NO	**35 196**	622
2011	20 732	20 499	232	7 796	446	5 451	108	NO	**34 533**	648

Table A-14: Emission trends for PM2.5 [Mg] 1990–2011 – Submission under UNECE/LRTAP.

	NFR-Sectors									
year	**1**	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
1990	19 070	18 972	97	3 240	407	1 396	23	NO	**24 135**	280
1995	18 955	18 873	82	2 615	421	1 372	24	NO	**23 388**	416
2000	18 360	18 275	85	2 397	425	1 341	14	NO	**22 536**	524
2001	18 646	18 557	88	2 345	426	1 351	13	NO	**22 781**	512
2002	18 307	18 216	91	1 928	428	1 343	16	NO	**22 023**	462
2003	18 501	18 404	97	1 904	430	1 342	19	NO	**22 197**	428
2004	18 223	18 132	91	1 902	433	1 385	25	NO	**21 969**	506
2005	18 656	18 563	93	1 831	436	1 323	28	NO	**22 273**	594
2006	17 602	17 512	90	1 578	438	1 315	28	NO	**20 961**	626
2007	17 144	17 062	82	1 391	440	1 305	32	NO	**20 312**	663
2008	16 922	16 844	78	1 507	442	1 300	27	NO	**20 198**	662
2009	16 031	15 972	59	1 375	443	1 296	25	NO	**19 170**	570
2010	16 621	16 549	72	1 378	445	1 291	30	NO	**19 764**	622
2011	15 707	15 634	73	1 430	446	1 276	34	NO	**18 893**	648

12.3 Austria's emissions for SO_2, NO_x, NMVOC and NH_3 according to the submission under NEC directive

In the following tables Austria's emissions 1990–2011 are listed according to NEC Directive 2001/81/EC. NEC emissions are reported on the basis of **fuel used** (without 'fuel export').

The complete tables of the NFR Format are submitted separately in digital form only (excel files).

Table A-15: Austria's emissions 1990–2011 on the basis of fuel used according to Directive 2001/81/EC, Article 8 (1).

	SO_2 [Gg]	**NO_x [Gg]**	**NMVOC [Gg]**	**NH_3 [Gg]**
1990	73.72	181.55	273.43	65.37
1991	70.54	182.33	261.22	67.55
1992	54.16	174.04	237.96	66.78
1993	52.41	167.20	239.38	68.31
1994	46.89	164.08	224.35	70.38
1995	46.55	162.88	224.20	71.20
1996	44.03	162.73	215.75	69.44
1997	39.79	165.17	202.11	69.61
1998	34.90	163.44	184.06	69.53
1999	33.27	164.08	171.64	67.63
2000	31.12	163.49	175.56	65.08
2001	32.04	165.00	173.91	64.61
2002	30.47	162.25	172.76	63.26
2003	31.12	165.76	169.33	62.89
2004	27.37	165.06	150.81	62.14
2005	27.09	168.96	159.23	61.99
2006	27.78	167.93	170.22	61.99
2007	24.33	164.35	157.02	62.93
2008	21.96	159.29	148.57	62.36
2009	17.70	147.35	120.05	63.11
2010	18.81	147.52	131.76	62.91
2011	18.47	144.21	126.20	62.12
Ceilings 2010	*39.00*	*103.00*	*159.00*	*66.00*

Table A-16: Austria's SO_2 emissions 1990–2011 on the basis of fuel used according to Directive 2001/81/EC, Article 8 (1).

SO_x	NFR Sectors according to NEC directive									
	1	1 A	1 B	2	3	4	6	7		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	SOLVENT AND OTHER PRODUCT USE	AGRICULTURE	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
					Gg					
1990	71.42	69.42	2.00	2.22	NA	0.001	0.07	NO	**73.72**	0.26
1991	68.58	67.28	1.30	1.90	NA	0.001	0.06	NO	**70.54**	0.29
1992	52.45	50.45	2.00	1.67	NA	0.001	0.04	NO	**54.16**	0.31
1993	50.95	48.85	2.10	1.42	NA	0.001	0.04	NO	**52.41**	0.33
1994	45.42	44.14	1.28	1.42	NA	0.001	0.05	NO	**46.89**	0.34
1995	45.13	43.60	1.53	1.37	NA	0.001	0.05	NO	**46.55**	0.38
1996	42.68	41.48	1.20	1.29	NA	0.001	0.05	NO	**44.03**	0.43
1997	38.47	38.40	0.07	1.27	NA	0.001	0.05	NO	**39.79**	0.44
1998	33.67	33.63	0.04	1.18	NA	0.001	0.05	NO	**34.90**	0.46
1999	32.10	31.96	0.14	1.12	NA	0.001	0.06	NO	**33.27**	0.45
2000	29.97	29.83	0.15	1.09	NA	0.001	0.06	NO	**31.12**	0.48
2001	30.77	30.61	0.16	1.21	NA	0.001	0.06	NO	**32.04**	0.47
2002	29.20	29.06	0.14	1.21	NA	0.001	0.06	NO	**30.47**	0.43
2003	29.85	29.70	0.15	1.21	NA	0.001	0.06	NO	**31.12**	0.40
2004	26.10	25.95	0.14	1.22	NA	0.002	0.06	NO	**27.37**	0.47
2005	25.82	25.68	0.13	1.22	NA	0.001	0.06	NO	**27.09**	0.55
2006	26.51	26.34	0.17	1.22	NA	0.001	0.05	NO	**27.78**	0.58
2007	23.07	22.89	0.18	1.22	NA	0.001	0.04	NO	**24.33**	0.61
2008	20.71	20.54	0.16	1.23	NA	0.001	0.03	NO	**21.96**	0.61
2009	16.47	16.23	0.24	1.21	NA	0.001	0.02	NO	**17.70**	0.53
2010	17.59	17.36	0.23	1.21	NA	0.001	0.01	NO	**18.81**	0.57
2011	17.24	17.01	0.23	1.22	NA	0.001	0.01	NO	**18.47**	0.60

Table A-17: Austria's NO_x emissions 1990–2011 on the basis of fuel used according to Directive 2001/81/EC, Article 8 (1).

NO_x	NFR Sectors according to NEC directive									
	1	1 A	1 B	2	3	4	6	7		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	SOLVENT AND OTHER PRODUCT USE	AGRICULTURE	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
	Gg									
1990	170.14	170.14	IE	4.80	NA	6.51	0.10	NO	**181.55**	2.44
1991	171.06	171.06	IE	4.48	NA	6.70	0.09	NO	**182.33**	2.76
1992	163.10	163.10	IE	4.55	NA	6.32	0.06	NO	**174.04**	3.00
1993	159.06	159.06	IE	1.98	NA	6.11	0.05	NO	**167.20**	3.18
1994	155.58	155.58	IE	1.92	NA	6.53	0.04	NO	**164.08**	3.31
1995	154.72	154.72	IE	1.46	NA	6.66	0.05	NO	**162.88**	3.73
1996	154.94	154.94	IE	1.42	NA	6.32	0.05	NO	**162.73**	4.14
1997	157.31	157.31	IE	1.50	NA	6.32	0.05	NO	**165.17**	4.29
1998	155.60	155.60	IE	1.46	NA	6.33	0.05	NO	**163.44**	4.43
1999	156.42	156.42	IE	1.44	NA	6.17	0.05	NO	**164.08**	4.33
2000	155.85	155.85	IE	1.54	NA	6.05	0.05	NO	**163.49**	6.44
2001	157.35	157.35	IE	1.57	NA	6.02	0.05	NO	**165.00**	6.32
2002	154.62	154.62	IE	1.63	NA	5.95	0.05	NO	**162.25**	5.67
2003	158.55	158.55	IE	1.34	NA	5.83	0.05	NO	**165.76**	5.21
2004	158.07	158.07	IE	1.28	NA	5.67	0.05	NO	**165.06**	6.09
2005	161.51	161.51	IE	1.75	NA	5.64	0.05	NO	**168.96**	6.99
2006	160.42	160.42	IE	1.82	NA	5.65	0.04	NO	**167.93**	7.54
2007	156.88	156.88	IE	1.71	NA	5.72	0.04	NO	**164.35**	7.99
2008	151.85	151.85	IE	1.59	NA	5.82	0.03	NO	**159.29**	7.90
2009	140.27	140.27	IE	1.26	NA	5.80	0.02	NO	**147.35**	6.86
2010	140.43	140.43	IE	1.50	NA	5.59	0.01	NO	**147.52**	7.60
2011	137.02	137.02	IE	1.50	NA	5.66	0.01	NO	**144.21**	7.98

Table A-18: Austria's NMVOC emissions 1990–2011 on the basis of fuel used according to Directive 2001/81/EC, Article 8 (1).

NMVOC	**NFR Sectors according to NEC directive**									
	1	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
					Gg					
1990	145.89	133.27	12.62	11.10	114.43	1.85	0.16	NO	**273.43**	0.18
1991	149.71	136.23	13.48	12.58	96.93	1.85	0.16	NO	**261.22**	0.20
1992	143.70	130.34	13.36	13.78	78.54	1.79	0.15	NO	**237.96**	0.22
1993	142.51	129.44	13.08	15.05	79.91	1.76	0.14	NO	**239.38**	0.24
1994	133.82	123.42	10.40	13.57	75.02	1.81	0.13	NO	**224.35**	0.25
1995	129.03	120.09	8.94	11.95	81.27	1.82	0.13	NO	**224.20**	0.29
1996	125.99	118.01	7.97	10.37	77.47	1.80	0.12	NO	**215.75**	0.34
1997	107.57	100.14	7.43	9.06	83.48	1.88	0.11	NO	**202.11**	0.37
1998	98.94	93.03	5.91	7.71	75.46	1.84	0.11	NO	**184.06**	0.40
1999	94.21	89.02	5.18	6.04	69.41	1.88	0.10	NO	**171.64**	0.39
2000	86.37	81.15	5.22	4.96	82.35	1.79	0.10	NO	**175.56**	0.42
2001	80.67	77.32	3.35	4.38	86.90	1.86	0.10	NO	**173.91**	0.41
2002	73.73	70.19	3.54	4.57	92.50	1.86	0.10	NO	**172.76**	0.37
2003	69.80	66.35	3.45	4.26	93.44	1.73	0.10	NO	**169.33**	0.34
2004	64.92	61.83	3.09	4.40	79.42	1.98	0.09	NO	**150.81**	0.40
2005	63.37	60.51	2.86	4.71	89.20	1.86	0.09	NO	**159.23**	0.47
2006	58.47	55.59	2.88	4.87	105.01	1.79	0.08	NO	**170.22**	0.50
2007	54.73	52.24	2.49	4.89	95.52	1.79	0.08	NO	**157.02**	0.53
2008	53.52	51.27	2.25	4.80	88.24	1.95	0.07	NO	**148.57**	0.52
2009	49.36	47.25	2.11	4.52	64.27	1.83	0.07	NO	**120.05**	0.45
2010	51.14	49.13	2.00	4.69	74.09	1.78	0.06	NO	**131.76**	0.49
2011	46.74	44.81	1.93	4.91	72.53	1.95	0.06	NO	**126.20**	0.51

Table A-19: Austria's NH_3 emissions 1990–2011 on the basis of fuel used according to Directive 2001/81/EC, Article 8 (1).

NH_3	**NFR Sectors according to NEC directive**									
	1	**1 A**	**1 B**	**2**	**3**	**4**	**6**	**7**		
	ENERGY	**FUEL COMBUSTION ACTIVITIES**	**FUGITIVE EMISSIONS FROM FUELS**	**INDUSTRIAL PROCESSES**	**SOLVENT AND OTHER PRODUCT USE**	**AGRICULTURE**	**WASTE**	**OTHER**	**NATIONAL TOTAL**	**International Bunkers**
	Gg									
1990	4.040	4.040	IE	0.269	NA	60.704	0.358	NO	**65.371**	0.002
1991	5.295	5.295	IE	0.507	NA	61.375	0.371	NO	**67.548**	0.002
1992	6.433	6.433	IE	0.369	NA	59.554	0.421	NO	**66.777**	0.002
1993	7.559	7.559	IE	0.219	NA	60.037	0.498	NO	**68.313**	0.002
1994	8.555	8.555	IE	0.168	NA	61.085	0.572	NO	**70.380**	0.002
1995	8.451	8.451	IE	0.099	NA	62.067	0.584	NO	**71.202**	0.003
1996	8.288	8.288	IE	0.097	NA	60.447	0.605	NO	**69.437**	0.003
1997	7.817	7.817	IE	0.103	NA	61.101	0.586	NO	**69.606**	0.003
1998	7.344	7.344	IE	0.103	NA	61.478	0.603	NO	**69.528**	0.003
1999	6.861	6.861	IE	0.119	NA	60.012	0.638	NO	**67.629**	0.003
2000	6.214	6.214	IE	0.100	NA	58.106	0.663	NO	**65.083**	0.003
2001	5.702	5.702	IE	0.079	NA	58.094	0.739	NO	**64.615**	0.003
2002	5.048	5.048	IE	0.061	NA	57.340	0.814	NO	**63.263**	0.003
2003	4.572	4.572	IE	0.076	NA	57.361	0.885	NO	**62.894**	0.003
2004	4.069	4.069	IE	0.059	NA	56.844	1.168	NO	**62.139**	0.003
2005	3.773	3.773	IE	0.068	NA	56.856	1.291	NO	**61.988**	0.004
2006	3.334	3.334	IE	0.074	NA	57.229	1.355	NO	**61.992**	0.004
2007	3.085	3.085	IE	0.077	NA	58.366	1.400	NO	**62.927**	0.004
2008	2.880	2.880	IE	0.081	NA	58.027	1.372	NO	**62.361**	0.004
2009	2.555	2.555	IE	0.088	NA	59.105	1.362	NO	**63.111**	0.004
2010	2.598	2.598	IE	0.091	NA	58.834	1.393	NO	**62.915**	0.004
2011	2.378	2.378	IE	0.101	NA	58.247	1.396	NO	**62.121**	0.004

12.4 Extracts from Austrian Legislation

Extracts from Austrian legislation, which regulate monitoring, reporting and verification of emissions at plant level

12.4.1 Cement production

BGBl 1993/ 63 Verordnung für Anlagen zur Zementerzeugung

§ 5. Der Betriebsanlageninhaber hat

1. kontinuierliche Messungen der Emissionskonzentrationen an Gesamtstaub, SO_2 und Stickstoffoxiden (berechnet als NO_2) der Ofenanlage entsprechend der Z 1 der Anlage zu dieser Verordnung durchzuführen ...

Zur Durchführung der Messungen gemäß Z 2 und 3 sind Anstalten des Bundes oder eines Bundeslandes, staatlich autorisierte Anstalten, Ziviltechniker oder Gewerbebetreibende, jeweils im Rahmen ihrer Befugnisse, heranzuziehen.

§ 6 Die Ergebnisse der Messungen gemäß § 5 sind in einem Messbericht festzuhalten, welcher

1. bei Messungen gemäß § 5 Z 1 die Messwerte in Form von Aufzeichnungen eines kontinuierlich registrierenden Messgerätes und die gemäß § 4 Abs. 1 zu führenden Aufzeichnungen über Grenzwertüberschreitungen, zu enthalten hat. Der Messbericht ist mindestens fünf Jahre in der Betriebsanlage derart aufzubewahren, dass er den behördlichen Organen jederzeit zur Einsicht vorgewiesen werden kann.

Anlage

(§ 5)

Emissionsmessungen

1. Kontinuierliche Messungen

a) Die Datenaufzeichnung hat durch automatisch registrierende Messgeräte in Form von Halbstundenmittelwerten unter Angabe von Datum, Uhrzeit und Messstelle zu erfolgen. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat.

b) Registrierende Emissionsmessgeräte sind im Abnahmeversuch und alle drei Jahre durch einen Sachverständigen aus dem im § 5 letzter Satz angeführten Personenkreis zu kalibrieren.

c) Jährlich ist eine Funktionskontrolle an registrierenden Emissionsmessgeräten durch Sachverständige aus dem im § 5 letzter Satz angeführten Personenkreis vorzunehmen.

12.4.2 Foundries

BGBl 1994/ 447 Verordnung für Gießereien

§ 5 (1) Der Betriebsanlageninhaber hat Einzelmessungen der Emissionskonzentration der im § 3 Abs. 1 angeführten Stoffe entsprechend der Z 1 lit. A bis c der Anlage 2 dieser Verordnung in regelmäßigen, drei Jahre nicht übersteigenden Zeitabständen durchführen zu lassen (wiederkehrende Emissionsmessungen).

(2) Der Betriebsanlageninhaber hat kontinuierliche Messungen der Emissionskonzentrationen ... entsprechend der Z2 der Anlage 2 zu dieser Verordnung durchzuführen.

(3) Zur Durchführung der Messungen gemäß Abs. 1 sowie zur Funktionskontrolle und Kalibrierung von Messgeräten für Messungen gemäß Abs. 2 sind Anstalten des Bundes oder eines Bundeslandes, staatlich autorisierte Anstalten, Ziviltechniker oder Gewerbebetreibende, jeweils im Rahmen ihrer Befugnisse, oder akkreditierte Stellen im Rahmen des fachlichen Umfangs ihrer Akkreditierung (§ 11 Abs. 2 des Akkreditierungsgesetzes, BGBl Nr 468/ 1992) heranzuziehen.

§ 6 Die Ergebnisse der Messungen gemäß § 5 sind in einem Messbericht festzuhalten, welcher

1. bei Messungen gemäß § 5 Abs. 1 die Messwerte und die Betriebsbedingungen während der Messungen (Betriebszustand, Verbrauch an Brennstoff, Rohmaterial und Zuschlagstoffen),

2. bei Messungen gemäß § 5 Abs. 2 die Messwerte in Form von Aufzeichnungen eines kontinuierlich registrierenden Messgerätes und die gemäß § 4 Abs. 2 zu führenden Aufzeichnungen über Grenzwertüberschreitungen, zu enthalten hat. Der Messbericht ist mindestens drei Jahre, bei Messungen gemäß § 5 Abs. 1 jedenfalls bis zur jeweils nächsten Messung, in der Betriebsanlage derart aufzubewahren, dass er den behördlichen Organen jederzeit zur Einsicht vorgewiesen werden kann.

Anlage 2

(§ 5)

Emissionsmessungen

1. Einzelmessungen

a) Einzelmessungen sind für alle im § 3 Abs. 1 angeführten Stoffe bei jenem Betriebzustand durchzuführen, in dem nachweislich die Anlagen vorwiegende betrieben werden. Die Durchführung der Messungen hat nach den Regeln der Technik zu erfolgen.

c) Die Abgasmessungen sind an einer repräsentativen Entnahmestelle im Kanalquerschnitt, die vor Aufnahme der Messungen zu bestimmen ist, vorzunehmen. Es sind innerhalb eines Zeitraumes von drei Stunden drei Messwerte als Halbstundenmittelwerte zu bilden, deren einzelne Ergebnisse zu beurteilen sind.

2. Kontinuierliche Messungen

a) Die Datenaufzeichnung hat durch automatisch registrierende Messgeräte in Form von Halbstundenmittelwerte unter Angabe von Datum, Uhrzeit und Messstelle zu erfolgen. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat.

b) Registrierende Emissionsmessgeräte sind im Abnahmeversuch und alle drei Jahre durch einen Sachverständigen aus dem im § 5 Abs. 3 angeführten Personenkreis zu kalibrieren.

c) Jährlich ist eine Funktionskontrolle an registrierenden Emissionsmessgeräten durch Sachverständige aus dem im § 5 Abs. 3 angeführten Personenkreis vorzunehmen.

12.4.3 Glass production

BGBl 1994/ 498 Verordnung für Anlagen zur Glaserzeugung

§ 5 (2) Zur Kontrolle der Einhaltung der im § 3 festgelegten Emissionsgrenzwerte sind unter Beachtung des § 4 jeweils mindestens drei Messwerte als Halbstundenmittelwerte zu bestimmen.

(4) Die Durchführung der Emissionsmessungen hat nach den Regeln der Technik (z.B. nach den vom Verein deutscher Ingenieure herausgegebenen und beim Österreichischen Normungsinstitut, Heinestraße 38, 1021 Wien, erhältlichen Richtlinien VDI 2268, Blätter 1, 2 und 4, VDI 2462, Blätter 1 bis 5 und 8, und VDI 2456, Blätter 1, 2, 8 und 10) zu erfolgen.

§ 7 (1) Der Betriebsanlageninhaber hat in regelmäßigen, ein Jahr, bei Schmelzeinrichtungen gemäß § 3 Z 5 lit. D drei Jahre, nicht übersteigenden Zeitabständen Messungen zur Kontrolle der Einhaltung der im § 3 festgelegten Emissionsgrenzwerte entsprechend den §§ 4 bis 6 durchführen zu lassen.

(2) Zur Durchführung der Messungen sind Anstalten des Bundes oder eines Bundeslandes, staatlich autorisierte Anstalten, Ziviltechniker oder Gewerbebetreibende, jeweils im Rahmen ihrer Befugnisse, oder akkreditierte Stellen im Rahmen des fachlichen Umfangs ihrer Akkreditierung (§ 11 Abs. 2 des Akkreditierungsgesetzes, BGBl Nr 468/ 1992) heranzuziehen.

(3) Die Messwerte für die im § 3 angeführten Stoffe sowie der während der Messung herrschenden Betriebszustände sind zusammen mit den Kriterien, nach denen der Zeitraum für die Messung, der stärksten Emission festgelegt worden ist, in einem Messbericht festzuhalten. Im Messbericht sind auch die verwendeten Messverfahren zu beschreiben. Der Messbericht und sonstige zum Nachweis der Einhaltung der im § 3 festgelegten Emissionsgrenzwerte dienende Unterlagen sind bis zur nächsten Messung in der Betriebsanlage derart aufzubewahren, dass sie den behördlichen Organen jederzeit zur Einsicht vorgewiesen werden können.

12.4.4 Iron and steel production

BGBl II 1997/ 160 Verordnung für Anlagen zur Erzeugung von Eisen und Stahl

§ 6 (1) Der Betriebsanlageninhaber hat, soweit die Absätze 3 und 4 nicht anderes bestimmen, Einzelmessungen der Emissionskonzentrationen der im § 3 Abs. 1 und im § 4 (mit Ausnahme des § 4 Abs. 3 lit. c) angeführten Stoffe entsprechend der Z 1 lit. a bis c der Anlage zu dieser Verordnung in regelmäßigen, drei Jahre nicht übersteigenden Zeitabständen, durchführen zu lassen (wiederkehrende Emissionsmessungen).

(3) Der Betriebsinhaber hat, soweit Abs. 4 oder 5 nicht anderes bestimmt. Entweder kontinuierliche Messungen der Emissionskonzentrationen ... entsprechend der Z 2 der Anlage zu dieser Verordnung durchzuführen oder kontinuierliche Funktionsprüfungen der rauchgas- und bzw. oder Abluftfilteranlagen von Einrichtungen gemäß § 4 durchzuführen, wenn sich durch diese Prüfungen mit hinreichender Sicherheit die Einhaltung der vorgeschriebenen Emissionsgrenzwerte für Staub festgestellt werden kann.

§ 6 (6) Zur Durchführung der Messungen gemäß Abs. 1 und 2 sowie zur Funktionskontrolle und Kalibrierung von Messgeräten für Messungen gemäß Abs. 3 sind akkreditierte Stellen im Rahmen des fachlichen Umfangs ihrer Akkreditierung (§ 11 Abs. 2 des Akkreditierungsgesetzes, BGBl Nr 468/ 1992), Anstalten des Bundes oder eines Bundeslandes, staatlich autorisierte Anstalten, Ziviltechniker oder Gewerbebetreibende, jeweils im Rahmen ihrer Befugnisse, heranzuziehen.

§ 7 Die Ergebnisse der Messungen gemäß § 6 sind in einem Messbericht festzuhalten, der zu enthalten hat:

1. bei Messungen gemäß § 6 Abs. 1 und 2 die Messwerte und die Betriebsbedingungen während der Messungen (Betriebszustand, Verbrauch Brennstoff, Rohmaterial und Zuschlagstoffen),

2. bei Messungen gemäß § 6 Abs. 3 und 4 die Messwerte in Form von Aufzeichnungen eines kontinuierlich registrierenden Messgerätes,

3. bei Funktionsprüfungen gemäß § 6 Abs. 3 die gemessenen Parameter in Form von Aufzeichnungen eines kontinuierlich registrierenden Messgerätes.

Der Messbericht ist mindestens drei Jahre, bei Messungen gemäß § 6 Abs. 1 und 2 jedenfalls bis zur jeweils nächsten Messung, in der Betriebsanlage derart aufzubewahren, dass er den behördlichen Organen zur Einsicht vorgewiesen werden kann.

Anlage

(§ 6)

Emissionsmessungen

1. Einzelmessungen

a) Einzelmessungen sind für alle im § 3 Abs. 1 und 3 und im § 4 angeführten Stoffe bei jenem Betriebszustand durchzuführen, in dem nachweislich die Anlagen vorwiegend betrieben werden. Die Durchführung der Messungen hat nach den Regeln der Technik zu erfolgen.

2. Kontinuierliche Messungen

a) Die Datenaufzeichnung hat durch ein automatisch registrierendes Messgerät in Form von Halbstundenmittelwerten unter Angabe von Datum, Uhrzeit und Messstelle zu erfolgen. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat.

b) Das registrierende Messgerät ist im Abnahmeversuch und alle drei Jahre durch einen Sachverständigen aus dem im § 6 Abs. 5 angeführten Personenkreis zu kalibrieren.

c) Jährlich ist eine Funktionskontrolle des registrierenden Messgerätes durch einen Sachverständigen aus dem im § 6 Abs. 5 angeführten Personenkreis vorzunehmen.

12.4.5 Sinter plants

BGBl II 1997/ 163 Verordnung für Anlagen zum Sintern von Eisenerzen

§ 5 (1) Der Betriebanlageninhaber hat Einzelmessungen der Emissionskonzentration der im § 3 Abs. 1 Z 2 lit. a und b und Z 3 angeführten Stoffe entsprechend der Z 1 in der Anlage zu dieser Verordnung in regelmäßigen, drei Jahre nicht übersteigenden Zeitabständen, durchzuführen zu lassen (wiederkehrende Emissionsmessungen).

(2) Der Betriebanlageninhaber hat kontinuierliche Messungen der Emissionskonzentrationen von Staub, Stickstoffoxiden und Schwefeldioxid entsprechend der Z 2 der Anlage dieser Verordnung durchzuführen.

(3) Zur Durchführung der Messungen gemäß Abs. 1 sowie zur Funktionskontrolle und Kalibrierung von Messgeräten für Messungen gemäß Abs. 2 sind akkreditierte Stellen im Rahmen des fachlichen Umfangs ihrer Akkreditierung (§ 11 Abs. 2 des Akkreditierungsgesetzes, BGBl Nr 468/ 1992), Anstalten des Bundes oder eines Bundeslandes, staatlich autorisierte Anstalten, Ziviltechniker oder Gewerbebetreibende, jeweils im Rahmen ihrer Befugnisse, heranzuziehen.

§ 6 Die Ergebnisse der Messungen gemäß § 5 sind in einem Messbericht festzuhalten, der zu enthalten hat:

1. bei Messungen gemäß § 5 Abs. 1 die Messwerte und die Betriebsbedingungen während der Messungen (Betriebszustand, Verbrauch an Brennstoff und Einsatzmaterial),

2. bei Messungen gemäß § 5 Abs. 2 die Messwerte in Form von Aufzeichnungen eines kontinuierlich registrierenden Messgerätes.

Der Messbericht ist mindestens drei Jahre, bei Messungen gemäß § 5 Abs. 1 jedenfalls bis zur jeweils nächsten Messung, in der Betriebsanlage derart aufzubewahren, dass er den behördlichen Organen jederzeit zur Einsicht vorgewiesen werden kann.

Anlage

(§ 5)

Emissionsmessungen

1. Einzelmessungen

a) Einzelmessungen sind für die im § 3 Abs. 1 Z 2 lit. a und b und Z 3 angeführten Stoffe bei jenem Betriebszustand durchzuführen, in dem nachweislich die Anlagen vorwiegend betrieben werden. Die Durchführung der Messungen hat nach den Regeln der Technik zu erfolgen.

2. Kontinuierliche Messungen

a) Die Datenaufzeichnung hat durch ein automatisch registrierendes Messgerät in Form von Halbstundenmittelwerten unter Angabe von Datum, Uhrzeit und Messstelle zu erfolgen. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat.

b) Das registrierende Messgerät ist im Abnahmeversuch und alle drei Jahre durch einen Sachverständigen aus dem im § 5 Abs. 3 angeführten Personenkreis zu kalibrieren. Die Kalibrierung hat nach den Regeln der Technik zu erfolgen.

c) Jährlich ist eine Funktionskontrolle des registrierenden Messgerätes durch einen Sachverständigen aus dem im § 5 Abs. 3 angeführten Personenkreis vorzunehmen.

12.4.6 Combustion plants

BGBl II 1997/ 331 Feuerungsanlagen-Verordnung

Emissionsmessungen

§ 4 (1) Der Betriebsanlageninhaber hat Emissionsmessungen sowie die Bestimmung des Abgasverlustes entsprechend der Anlage 1 zu dieser Verordnung durchzuführen bzw. durchführen zu lassen.

(2) Zur Durchführung der Emissionseinzelmessungen sowie zur Bestimmung des Abgasverlustes ist ein Sachverständiger aus dem im § 2 Abs. 2 zweiter Satz genannten Personenkreis heranzuziehen.

§ 5 (1) Der Betriebsanlageninhaber hat, sofern in dieser Verordnung nicht anderes bestimmt ist,

1. kontinuierliche Messungen der Emissionskonzentrationen, abhängig von der jeweiligen Brennstoffwärmeleistung und dem eingesetzten Brennstoff, entsprechende der folgenden Tabelle durchzuführen

Brennstoff	Staub	CO	SO_2	NO_x	
fest	> 10	> 10	> 30	> 30	MW
flüssig	> 10	> 10	> 50	> 30	MW
gasförmig	-	> 10	-	> 30	MW

Prüfungen

Erstmalige Prüfung

§ 23 (1) Feuerungsanlagen sind anlässlich ihrer Inbetriebnahme einer erstmaligen Prüfung zu unterziehen.

(2) Die erstmalige Prüfung hat in der Erbringung des Nachweises zu bestehen, dass die Feuerungsanlage den Anforderungen dieser Verordnung entspricht.

Wiederkehrende Prüfungen

§ 25 (1) Feuerungsanlagen sind jährlich zu prüfen. Bei dieser jährlichen Prüfung sind die Feuerungsanlagen hinsichtlich jener Anlagenteile, die für die Emissionen oder deren Begrenzung von Bedeutung sind, zu besichtigen und auf etwaige Mängel zu kontrollieren... Weiters sind jährlich die Ergebnisse der gemäß § 5 durchgeführten kontinuierlichen Messungen zu beurteilen.

Prüfbescheinigung

§ 27 Das Ergebnis jeder Prüfung muss in einer Prüfbescheinigung festgehalten sein, die insbesondere festgestellte Mängel sowie Vorschläge zu deren Behebung zu enthalten hat. Die Prüfbescheinigung ist im Original in der Betriebsanlage zumindest fünf Jahre so aufzubewahren, dass sie den behördlichen Organen jederzeit zur Einsicht vorgewiesen werden kann.

Anlage 1

(§§ 4 und 25)

Emissionsmessungen

1. Die Messungen sind

1.3 für gasförmige Emissionen nach den Regeln der Technik, oder nach einem diesen Verfahren gleichwertigen Verfahren durchzuführen.

2. Die Messstellen sind so festzulegen, dass eine repräsentative und messtechnisch einwandfreie Emissionsmessung gewährleistet ist.

3. Einzelmessungen

3.2 Die Einzelmessungen sind an einer repräsentativen Entnahmestelle im Kanalquerschnitt vorzunehmen. Es sind innerhalb eines Zeitraumes von drei Stunden drei messwerte als Halbstundenmittelwerte zu bilden.

4. Kontinuierliche Messungen

4.1 Die Datenaufzeichnung hat durch automatisch registrierende Messgeräte in Form von Halbstundenmittelwerten unter Angabe von Datum, Uhrzeit und Messstelle zu erfolgen. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat. Die Messergebnisse müssen mit dem einzuhaltenden Grenzwert vergleichbar sein.

4.2 Registrierende Emissionsmessgeräte sind im Abnahmeversuch und mindestens alle drei Jahre durch einen Sachverständigen aus dem im § 2 Abs. 2 zweiter Satz angeführten Personenkreis zu kalibrieren. Die Kalibrierung hat nach den Regeln der Technik (z.B. nach den vom Verein Deutscher Ingenieure herausgegebenen und beim Österreichischen Normungsinstitut, Heinestraße 38, 1021 Wien, erhältlichen Richtlinien VDI 2066, Blatt 4 und Blatt 6, und VDI 3950, Blatt 1E) zu erfolgen.

4.3 Jährlich ist eine Funktionskontrolle an registrierenden Emissionsmessgeräten durch Sachverständige aus dem im § 2 Abs. 2 zweiter Satz angeführten Personenkreis vorzunehmen.

12.4.7 Non-ferrous metal production

BGBl II 1998/ 1 Verordnung zur Erzeugung von Nichteisenmetallen

§ 6 (1) Der Betriebsanlageninhaber hat Einzelmessungen der Emissionskonzentration der im § 3 Abs. 1 und im § 4 angeführten Stoffe entsprechend der Z 1 lit. a bis c der Anlage zu dieser Verordnung in regelmäßigen, drei Jahre nicht übersteigenden Zeitabständen durchführen zu lassen (wiederkehrende Emissionsmessungen).

(2) Der Betriebsanlageninhaber hat kontinuierliche Messungen ... entsprechend der Z 2 der Anlage zu dieser Verordnung reingasseitig (im Kamin) durchzuführen.

(3) Zur Durchführung der Messungen gemäß Abs. 1 sowie zur Funktionskontrolle und Kalibrierung von Messgeräten für Messungen gemäß Abs. 2 sind akkreditierte Stellen im Rahmen des fachlichen Umfangs ihrer Akkreditierung (§ 11 Abs. 2 des Akkreditierungsgesetzes, BGBl Nr 468/ 1992), Anstalten des Bundes oder eines Bundeslandes, staatlich autorisierte Anstalten, Ziviltechniker oder Gewerbebetreibende, jeweils im Rahmen ihrer Befugnisse, heranzuziehen.

§ 7 Die Ergebnisse der Messungen gemäß § 6 sind in einem Messbericht festzuhalten, der zu enthalten hat:

1. bei Messungen gemäß § 6 Abs. 1 die Messwerte und die Betriebsbedingungen während der Messungen (Betriebszustand, Verbrauch an Brennstoff, Rohmaterial und Zuschlagstoffen),

2. bei Messungen gemäß § 6 Abs. 2 die Messwerte in Form von Aufzeichnungen eines kontinuierlich registrierenden Messgerätes und die gemäß § 5 Abs. 2 zu führenden Aufzeichnungen über Grenzwertüberschreitungen.

Der Messbericht ist mindestens drei Jahre, bei Messungen gemäß § 6 Abs. 1 jedenfalls bis zur jeweils nächsten Messung, in der Betriebsanlage derart aufzubewahren, dass er den behördlichen Organen jederzeit zur Einsicht vorgewiesen werden kann.

Anlage

(§ 6)

Emissionsmessungen

1. Einzelmessungen

a) Einzelmessungen sind für alle im § 3 Abs. 1 und 4 angeführten Stoffe bei jenem Betriebszustand durchzuführen, in dem nachweislich die Anlagen vorwiegend betrieben werden. Die Durchführung der Messungen hat nach den Regeln der Technik zu erfolgen.

2. Kontinuierliche Messungen

a) Die Datenaufzeichnung hat durch ein automatisch registrierendes Messgerät in Form von Halbstundenmittelwerten unter Angabe von Datum, Uhrzeit und Messstelle zu erfolgen. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat.

b) Das registrierende Messgerät ist im Abnahmeversuch und alle drei Jahre durch einen Sachverständigen aus dem im § 6 Abs. 3 angeführten Personenkreis zu kalibrieren.

c) Die Wartung des registrierende Messgerätes ist durch einen Sachverständigen aus dem im § 6 Abs. 3 angeführten Personenkreis mindestens einmal jährlich vornehmen zu lassen.

12.4.8 Steam boilers

BGBl 1988/ 380 idF (BGBl 1993/ 185, BGBl I 1997/ 115, BGBl I 1998/ 158) Luftreinhaltegesetz für Kesselanlagen

Überwachung

§ 7 (1) Die in Betrieb befindlichen Dampfkesselanlagen ... sind einmal jährlich durch einen befugten Sachverständigen auf die Einhaltung der Bestimmungen dieses Bundesgesetzes zu überprüfen. Die Überprüfung umfasst die Besichtigung der Anlage und deren Komponenten, soweit sie für die Emissionen oder deren Begrenzung von Bedeutung sind, verbunden mit der Kontrolle vorhandener Messergebnisse oder Messregistrierungen.

§ 8 (1) Die Behörde hat im Genehmigungsbescheid festzulegen, ob und in welchem Umfange Abnahmemessungen sowie wiederkehrende Emissionsmessungen an der Dampfkesselanlage durchzuführen sind. Emissionsmessungen sind ferner durchzuführen, wenn der befugte Sachverständige anlässlich einer Überprüfung gemäß § 7 Grund zur Annahme hat, dass die einzuhaltenden Emissionsgrenzwerte im Betrieb überschritten werden.

Pflichten des Betreibers

§ 10 (3) Der Betreiber hat der Behörde oder dem hierzu beauftragten Sachverständigen während der Betriebszeit den Zutritt zu der Anlage zu gestatten und Einsicht in alle die Emissionen der Dampfkesselanlage betreffenden Aufzeichnungen zu gewähren, die in einem Dampfkesselanlagenbuch zusammenzufassen sind.

BGBl 1989/ 19 idF (BGBl 1990/ 134, BGBl 1994/ 785, BGBl II 1997/ 324) Luftreinhalteverordnung für Kesselanlagen

Emissionseinzelmessungen

§ 2 a (1) Die Durchführung der Emissionsmessungen hat nach den Regeln der Technik zu erfolgen.

(2) Die in Anlage 7 wiedergegebene ÖNORM M 9415-1, Ausgabe Mai 1991, und die in Anlage 8 wiedergegebene ÖNORM 9415-3, Ausgabe Mai 1991, sind verbindlich anzuwenden.

§ 3 (1) Emissionseinzelmessungen sind für jede Schadstoffkomponente bei jenem feuerungstechnisch stationären Betriebzustand durchzuführen, bei dem nachweislich die Anlage vorwiegend betrieben wird.

(2) Für die Durchführung der Emissionseinzelmessungen ist die in Anlage 9 wiedergegebene ÖNORM M 9415-2, Ausgabe Mai 1991, verbindlich anzuwenden.

Kontinuierliche Emissionsmessungen

§ 4 (3) Kontinuierliche Emissionsmessungen der Massekonzentration einer Emission (§ 8 Abs. 1 LRG-K) haben i der Regel in Halbstundenmittelwerten zu erfolgen.

(5) Die Messstellen sind auf Grund des Gutachtens eines befugten Sachverständigen (§ 7 Abs. 2 LRG-K) von der Behörde derart festzulegen, dass eine repräsentative und messtechnisch einwandfreie Emissionsmessung gewährleistet ist.

§ 5. Für kontinuierliche Emissionsmessungen hat die Datenaufzeichnung zu erfolgen:

1. Durch automatisch registrierende Messgeräte in Form von Halbstundenmittelwerten unter Angabe von Datum, Uhrzeit und Messstelle. Die Verfügbarkeit der Daten hat mindestens 90 % zu betragen. Als Bezugszeitraum gilt ein Monat.

3. Die Auswertung der Messdaten aus registrierenden Messgeräten hat mittels Auswertegeräten zu erfolgen, die dafür geeignet sind und die dem Stand der Technik entsprechen.

5. Registrierende Emissionsmessgeräte und Auswertegeräte sind im Abnahmeversuch und danach alle drei Jahre durch einen Sachverständigen zu kalibrieren. Die Kalibrierung hat nach den geltenden einschlägigen technischen Regelwerken zu erfolgen.

6. Jährlich ist eine Funktionskontrolle an registrierenden Emissionsmessgeräten durch Sachverständige vorzunehmen.

§ 7 (1) Der Betreiber hat während des Betriebes der Anlage an den Messgeräten mindestens einmal wöchentlich zu kontrollieren, ob der Nullpunkt einjustiert ist und die erforderliche Messfunktion gegeben ist.

(2) Die Messgeräte und alle dazuhörenden Komponenten sind mindestens alle drei Monate zu warten. Hierüber hat der Betreiber Aufzeichnungen zu führen.

(3) Der Sachverständige hat im Rahmen der Überwachung die Aufzeichnungen gemäß Abs. 2 zu kontrollieren und in begründeten Fällen die Richtigkeit der Anzeige der Messgeräte zu überprüfen.

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In the Informative Inventory Report (IIR) 2013 the Umweltbundesamt presents a comprehensive and detailed method description of the Austrian air emission inventory (Österreichische Luftschadstoff-Inventur – OLI) for the air pollutants

- sulphur dioxide (SO_2), nitrogen oxides (NO_X), non-methane volatile organic compounds (NMVOCs), ammonia (NH_3)
- carbon monoxide (CO) and
- particulate matter (TSP, PM10, PM2.5)

The Austrian air emission inventory covers also air pollutant groups such as

- heavy metals: cadmium (Cd), mercury (Hg), lead (Pb) and
- persistent organic pollutants (POPs): polycyclic aromatic hydrocarbons (PAHs), dioxins and furans (PCDD/Fs) as well as hexachlorobenzene (HCB).

With the Informative Inventory Report 2013, Austria provides documentation as required for reporting under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP).

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